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Gear Tooth Finishing

Grinding, shaving and lapping of spur and helical gears are covered in the first of two installments based on a survey of current practice

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GEAR-TOOTH finishing is becoming a more serious problem than ever. And as with many other machining problems, the demands created by the automobile have been largely responsible for its development. The problem is neither simple nor constant. It changes with the kind of gears, with the power to be transmitted, the degree of quietness desired and the permissible wear. The form of tooth, the pressure angle and the way in which the gears are cut and heat-treated, all affect the cost of finishing as well as the methods to be employed. As with a number of other processes, success in maintaining quality and in lowering cost depends largely on a thorough knowledge of all the details, on experience in meeting the different conditions, on the method selected, and on the training of the personnel that is to handle the work.

The making of quiet, high grade gears starts with the steel from which they are made. The content of carbon and alloys, the heating and working in the mills and the normalizing methods used, all play their part even before we start to machine the gear blank. The machining of the center hole, the squareness of the sides with the bore, and concentricity, especially of the pitch diameter with the bore, are all important.

Cutting the teeth, regardless of the method used, requires care. It is seldom advisable to rough and finish at one cut, for correcting even slight distortion or inaccuracy costs more than a finish cut. To expect the finishing process to correct distorted tooth forms or to remove material in appreciable amounts, especially when it is irregular, is uneconomical from every point of view. A good gear tooth grinder will of course remove considerable metal if necessary, but even ground gears are now lapped in most cases where extreme accuracy and quietness is desired. The old prejudice against lapping seems to be rapidly disappearing.

Running-In and Grinding

Probably the first attempt to correct gear tooth bearing was to run the mating gears together, using an abrasive to cut down the high spots. While this is sometimes called lapping it seems better to refer to it as "running-in." In modern shop parlance lapping refers to the use of a "lap" and not to a mating gear. No modern maker of high grade gears would think of running in mating gears with coarse abrasives, because experience has shown the disadvantages of attempting to remove any considerable amount of metal in that way. A few, however, still run in gears as a final operation, using either a lubricant or an extremely fine abrasive material that does little more than polish the teeth.

Finishing gear teeth by grinding on a commercial scale dates back well over twenty years, using a grinding wheel with the cutting face formed to the contour of the tooth desired. The contour was maintained by diamond tools that were guided by a predetermined form. This method of finishing gear teeth still has many advocates and seems particularly adapted for gears of medium and large size.

Gear grinders that generate the tooth form were later devised and are used on some classes of work, after the gears are hardened. Some of these machines are most ingenious and do excellent work. By using a wheel of large diameter a gear tooth of ordinary size can be ground by a straight-in cut, without traverse, on gears of narrow face. The problem becomes more difficult with a helical tooth gear, and is still further complicated by extreme angles on small gears. On other designs of generating machines a small wheel is used and the wheel traversed across the face of the gear. With helical teeth the gear must turn as the wheel travels across the face on a machine of this type.

Another method of correcting irregularities or errors in gear teeth is by rolling or "ironing." This is usually known as burnishing and is quite common on soft or "green" gears. In this operation the green gear is run in mesh with hardened gears of correct form, these master gears being ground and lapped after hardening. This process is supposed to iron out the high spots and irregularities. It is usual to have three hardened master gears for this work and let the green gear roll between them. Opponents of the method claim that the rolling under heavy pressure introduces stresses in the gear teeth that relieve themselves when the gear is hardened, or even come back eventually even if the gear is left soft. The method is used in some plants as one step in the process but is not depended upon to give a final tooth form.

The cost of grinding gear teeth led to experiments with alternative methods. Not only cost but the desire for a better tooth surface stimulated the development of lapping methods that are at present standard practice in some shops. The demand of the automobile industry is for gears that will run quietly under load, largely because they are located almost directly under the driver where he can hear every sound. Furthermore, the transmission gears are carried in a case or housing that must be stiff

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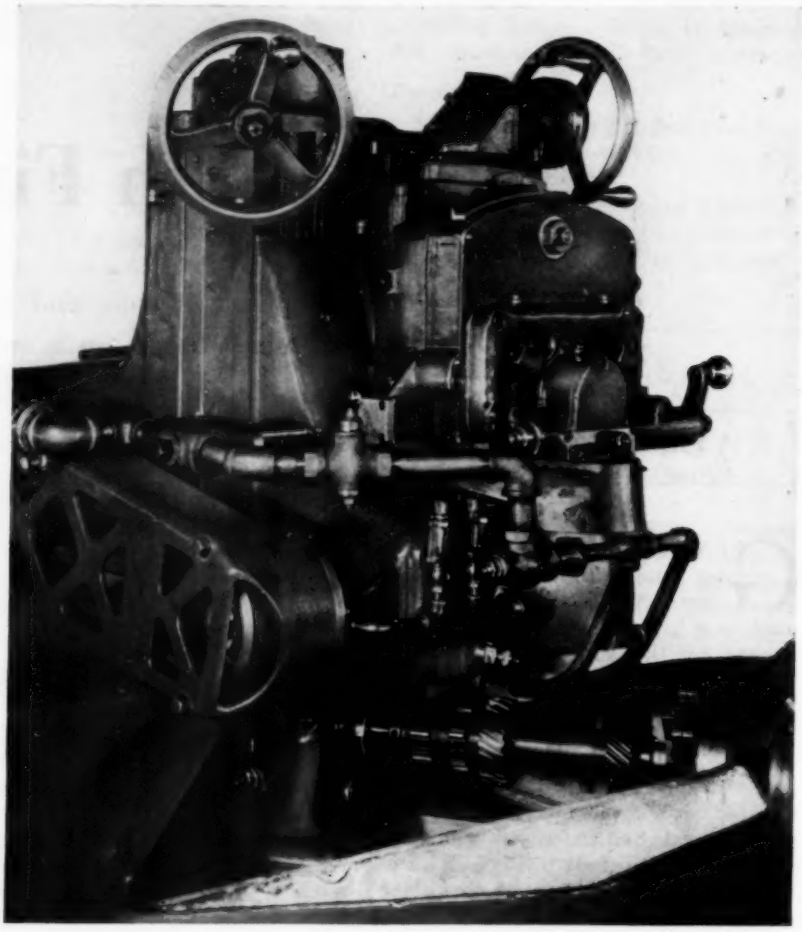
enough to resist all stresses imposed, not too heavy, and must not act as a resonator which magnifies the gear noises and transmits them to the car body. And on account of the low prices of automobiles, the cost of securing the finish that will give quietness must be at a minimum.

Gear-Tooth Shaving

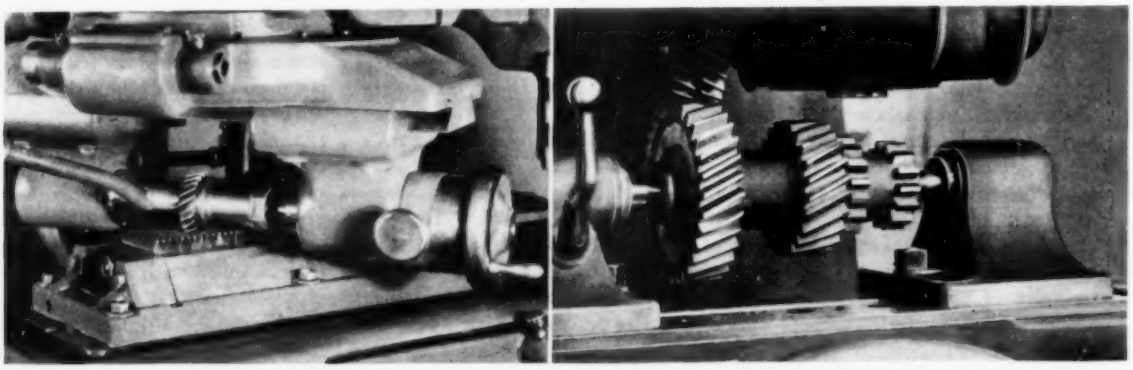
These various conditions have resulted in greatly improved methods, which in some cases include what is known as a shaving operation. This shaving operation bears no relation to one of the same name in punch press work. Shaving, as applied to modern gear finishing, is the cutting of a series of minute shavings from the sides of the tooth by tools traveling in the proper path. This has been done by a single tool for each side of the tooth, this tool shaving the whole surface as it passes from point to root. Another method uses a tool that is virtually a rack, the teeth of the rack shaving the sides of the gear teeth as the gear rolls back and forth over it. The shaving action is secured by using a helical rack for spur gears and a straight rack for helical gears. In either case the gear travels across the face of the rack as the rack moves under the gear. The cutting action produces a series of fine shavings, almost scrapings, that seldom exceed 0.002 in. in thickness.

A somewhat similar result is secured with a shaving or finishing tool which is a hardened and ground tool steel gear with a groove cut in the center of the teeth by an elastic abrasive wheel, after hardening. The cutting tool is, in appearance, simply a gear with a groove around it.

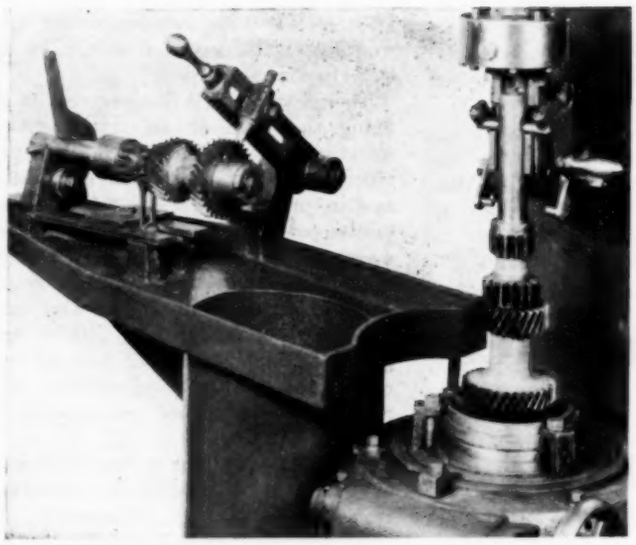
Here again the combination of spur and helical teeth is used to secure the cutting action. The cutting is done by the sharp edges of the teeth on each side of the center groove in the cutter as the work rotates in contact with the cutter and also moves across its face. There is no geared connection between the cutter and the work except through the meshing of the teeth. The table travel is somewhat more than the width of the gear face and it reverses after each revolution, thus shaving first one side of the tooth and then the other. A difference of from 10 to 15 deg. between the angles of the gear and the cutter

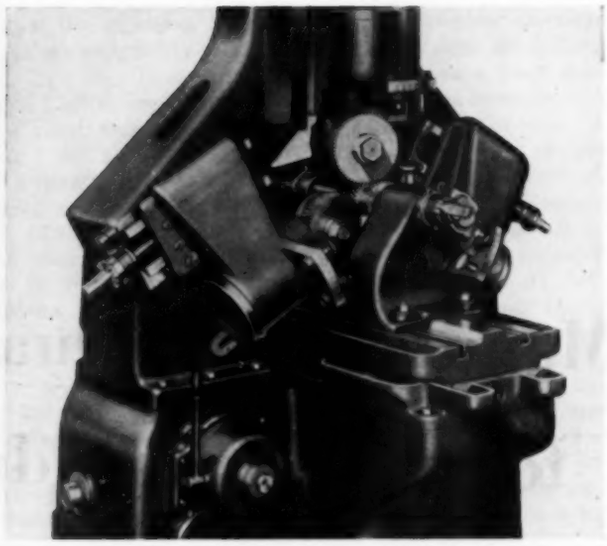


The Pratt & Whitney gear tooth grinder carries the grinding wheel in the head of a ram somewhat similar to that of a shaper. The combined movement of the ram and the rotation of the gears enables the wheel to generate the adjacent surfaces of two teeth at the same time. The machine stops when the gear is completed



Left—The gear tooth shaving machine of the Michigan Tool Company. The gear is traversed along a rack with hardened, serrated teeth. The angle between gear and rack gives side motion; in addition, the rotation and the serrations shave fine chips from the gear teeth. Spur gears use an angular rack. Right—The gear shaver made by the National Broach & Machine Company uses a tool that is virtually a hardened gear with a groove in the center. The movement of the gear under the cutter produces a shaving action that corrects inequalities in the tooth form. The cutting is done by the sides of the central groove in the cutter





Left—In the Incolap machine the lap, usually of chilled iron, is held on the table and the gear traversed vertically through the lap, the rotation being controlled by a cam on the spindle. Abrasive is applied as a paste, with a brush. After approximately 100 strokes the gear is automatically withdrawn, indexed 180 deg. and the lapping completed in the next 100 strokes. Right—The Michigan Tool Company's gear lapper uses three gears as laps, each gear being capable of independent adjustment as to angle, and each is carried in a separate head. The work table carries the gear being lapped back and forth during the lapping process

gives a good clearance. With this type of machine it is claimed that as much as 0.005 in. on the chordal thickness can be removed when necessary.

Experience with this method, as with others, has shown that final results depend as much on the procedure as on the tools used. Practices that give satisfactory results in one plant, so far as finishing is concerned, may be disappointing in another plant unless conditions are carefully studied by one with experience in the making of good gears. As before stated, care in the cutting of the teeth will save much time in the final finishing, and be much more satisfactory in every way. Users of the shaving method state that a well cut gear can be shaved in about ten per cent of the time required for the finishing cut.

Digressing for a moment from the finishing of gear teeth, it is of interest to consider the changes that have taken place in ideas as to pressure angle, pitch and helix angles in automobile transmissions. Pressure angles have gone from 12 to 20 deg. with 20 deg. in the lead at present. Diametral pitches have ranged all the way from 5 to 16, with 9 to 9½ D. P. the favorite in modern transmissions. Helical angles have varied from 23½ deg. to 60 deg. with from 30 to 40 deg. the favorite at this writing.

The cost, and doubts of the necessity, of finishing gears after hardening have led to the development of lapping machines that have made a place for themselves as standard equipment. Machines of this kind are now made by several builders. Although details of construction differ widely, the general plan is to rotate the gear and to secure an endwise movement between the gear and the lap. By changing the relative speed of rotation and reciprocation variation in action is secured and corrections can be made so as to secure the kind of tooth bearing desired. In some machines only the gear to be lapped is positively driven, the laps being rotated by the work. When using three laps around a central gear, some vary the number of teeth in the laps on the same theory as the odd, or "hunting," tooth was used in the old gear drives of days long past. Others do not consider this to be necessary.

Another method, known as the Incolap process, is used in lapping either spur or helical gears. The lap is made by casting it around a steel chill that represents the gear to be lapped. The chilled casting used as the lap is several times the length of the gear face. Where helical gears are to be lapped the gears are guided in the lap by a cam on the spindle of the machine that reciprocates the gear through the lap at the proper helix angle. These laps are not charged but an abrasive is applied with a brush. Some use 200 grit abrasive mixed with a soluble oil or glycerine to form a thick paste. Powdered India oilstone mixed with a light spindle oil is also used for a final finish.

The spindle of the machine carries the gear up and down through the lap, and exerts a lateral pressure at the same time. At the completion of a given number of strokes the gear comes out of the lap and is indexed as many teeth as seems desirable. In one well known plant the gear is turned half way round at each period. Advocates of this method claim that accuracy does not depend on the mechanism of the machine but that the lapping is an *averaging* operation produced by each new application of torque which occurs as the gear registers with the new set of lap teeth, after indexing. The greater the number of cycles the more uniform and accurate the results. The method usually laps a trifle more from the ends of the teeth than in the center, leaving a slight crown on the teeth.

The gears are free to find their own center in the lap. It is claimed that the lap improves with use, the accuracy increasing with the number of gears that are put through it. With gears cut or ground to normal limits of accuracy of size and profile, satisfactory correction can be expected in from 100 to 200 strokes on each side of the teeth. Chilled cast iron laps are preferred for regular production but when only a comparatively few gears are to be lapped, or an exceptionally fine finish is desired, a lap of type-metal may be used.

Experience with this method has demonstrated that, as indexing at each stroke (as originally planned) was unnecessary, a shorter stroke could be used. In the later machines this varies from ⅜ in. to 4 in. The shorter stroke permits the use of this method on cluster gears if a clearance of ⅛ in. can be had at the end of the stroke. The speed of the machine in one plant using it is from 120 to 200 strokes per min.

Manufacturing Quantities for the Small Industry

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Lot sizes have long been a subject of close study in large manufacturing plants. The small shop owner has been rather distrustful of the formulas commonly employed, usually preferring to rely on his own judgment. In this article the author shows a simplified method of analysis that may be easily applied to the small shop with accurate results

IN ORDER to simplify the presentation, I am assuming that sales demand may be treated as uniform; that the unit process cost remains constant over the whole range of lot sizes contemplated; and that when "return" is mentioned, it is understood to be a return on manufacturing operations only. Also, again to simplify the presentation, questions of storage charges, and allowances for spoilage have been eliminated from consideration.

The data on a case selected to illustrate the article are given below. The total cost of each operation is shown at the right and, of course, consists of charges for labor and expense. The sub-total represents the sum of charges accumulated through the last operation above the sub-total and is introduced at this point only because later use will be made of it. In the particular case used, this represents a stopping point in the process of manufacturing; the production to this point takes us through the majority of the operations in which set-up charges are accumulated. For the time being, we shall use the total set-up and process charges in the analysis.

Chart I presents the obvious relation existing between quantity chosen as a lot size and working capital invested. Line *A* is the set-up, or preparation charge, which of course is fixed and independent of quantity. Line *B* is the process cost without set-up charges and is strictly proportional to quantity under the assumptions made. Line *C* represents the sum for any particular lot size. It thus represents the total working capital invested in the lot for any lot size in question.

There can be little disagreement in defining the total as an investment of working capital; if material were provided, especially for the lot in question and in proportion to the lot, it is certainly paid for from working capital; wages are paid currently with production; and expense, consisting of factory administrative expense, repair and maintenance expenses, trucking, factory supplies, fuel and power, are paid for currently and through the medium of a machine-rate absorbed as expense by production.

Chart II takes up a step further in our analysis. Curve *A* is reproduced from the last chart, representing the total working capital invested as a function of lot size. Curve *B* is obtained by dividing each value of working capital by the lot size associated with it. This

Data for Article of Manufacture used as a basis for example of study of lot size

Sales Rate: 300 per month.

Operation Symbol	Material	Cost Set-up	Process
A	$0.0130	$0.45	$0.00135
B		8.55	0.02520
C			0.00950
D		1.60	0.01140
E		1.10	0.01770
F		1.43	0.00596
Sub-Total:	$0.0130	$13.13	$0.07211
G		0.31	0.01772
H			0.00308
I			0.00900
J			0.00701
K			0.00213
L			0.00800
M			0.00653
Sub-Total		$0.31	$0.05347
Total	$0.0130	$13.44	$0.12558

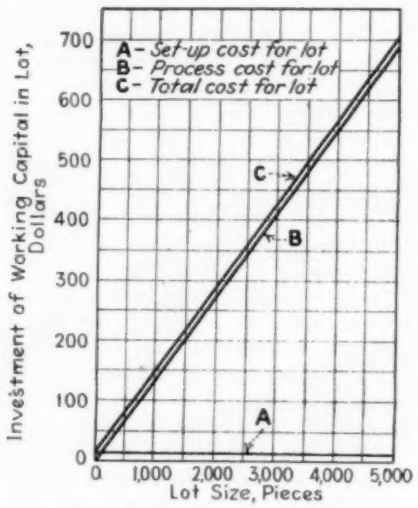


Chart I—Investment of working capital in various lot sizes

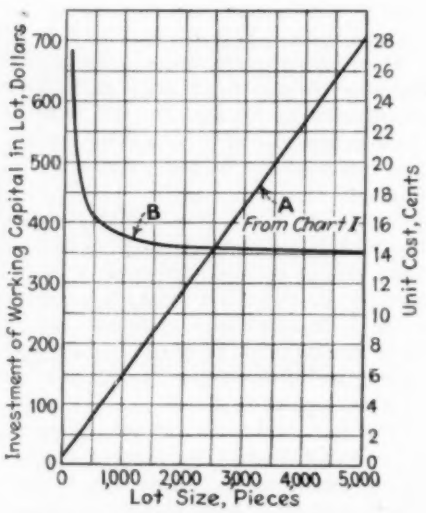


Chart II—Investment in lot and unit cost as functions of lot size

Presented at the conference on "Re-Engineering for Economical Manufacture," Case School of Applied Science, Cleveland, Ohio, on May 12, 1933.

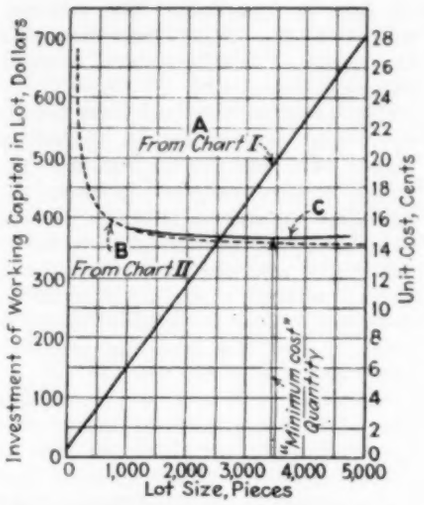


Chart III—Effect on unit cost of the introduction of an interest charge as an element of cost

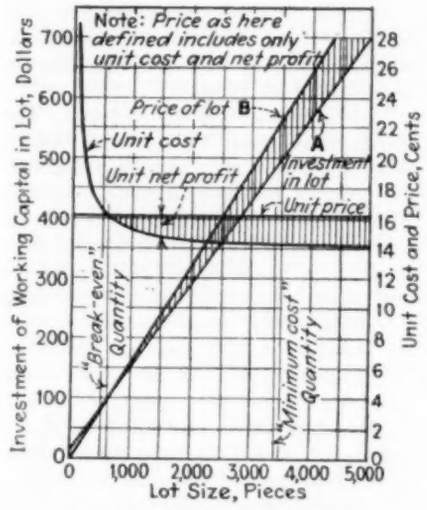


Chart IV—Effect of lot size on net profit

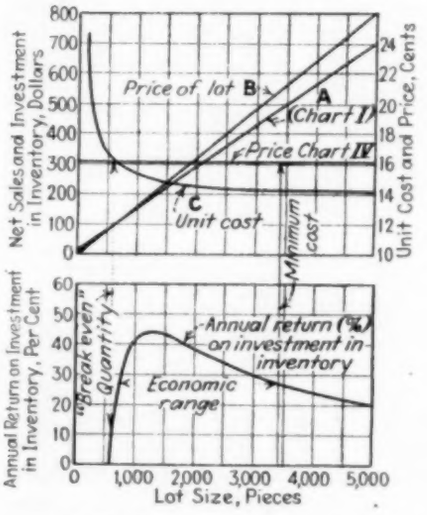


Chart V—Rate of return on working capital invested in inventory, as a function of lot size

produces the unit cost of the article as influenced by lot-size; values are read on the scale at the right.

It is of course obvious that as the lot size increases the unit price decreases; also that with increased lot sizes the unit cost decreases at a decreasing rate. In other words, at large values of the lot size, the reduction of unit cost by still further increasing quantity is obtained at the expense of tying up increasingly larger amounts of working capital. One begins to look for the operation of the old economic law of diminishing return.

Minimum Cost Quantity

In Chart III we introduce two new factors; sales demand and an assumed interest charge on working capital. I am fully aware that the conception of interest on capital as a factor of cost is questionable; but I hasten to add that this treatment will be dropped as soon as it has served its purpose, namely, to show that there is an upper limit beyond which it is inadvisable to tie up capital in the hope of gain by reduction of costs.

Curves from the previous charts have been redrawn on Chart III, and are labelled accordingly. The new curve *C* is intended to represent the effect of including interest on working capital as a cost item. This factor was computed as follows: Taking the sales rate assumed for the product, the rate is divided into each of the lot sizes represented by the original bottom scale of abscissae. This operation fixed the period of time for which the lot size in question will provide. Recalling that we assumed a uniform sales rate, the working capital will be returned for reinvestment at a uniform rate, and the average amount of working capital invested over the sales period is one-half the initial amount. The interest charge under these conditions was then computed, reduced to a unit basis, and added to the original unit cost curve reproduced from the previous chart.

Although the last curve is rather flat, it can be seen that, under the conditions defined, a minimum-cost quantity has appeared. There can be little disagreement with the proposition that, with interest at commercial rates included as a charge, an increased cost as the result of large quantities, which in themselves were aimed at reduced costs, is not economical. Stated perhaps more simply, most writers on the subject have agreed that a practical upper limit to manufacturing lot sizes is that quantity at which the application of a commercial interest rate balances reduction in cost, set-up charges considered, so that there is no gain in further increasing quantities. Fortunately, however, we can place ourselves on more solid ground in our study of lot sizes than a limit imposed by the consideration of interest on working capital as an element of cost.

In Chart IV we proceed to include in our analysis the factory price, or the selling price less selling and administrative expenses. This viewpoint is taken for the reason that such expenses as selling and administrative are not influenced by lot size, and hence should be excluded. This chart repeats the previous unit cost curves; the area to the left of the intersection of the cost and price curves of course represents an actual loss and sets an effective lower limit to the lot size. "Price," however, needs a little definition, in view of the assumption we have made. In this respect, naturally, the data given at the beginning of the paper does not represent an actual situation. I have arbitrarily set the price for the purpose of this paper at an even figure about 10 per cent above the cost represented for the minimum-cost quantity just found, this cost being the figure ordinarily used as "cost of sales," and not including any interest charge as an element of cost.

Turning to Chart V, we proceed to analyze the factors so far introduced for their effect on the return on the working capital invested in the lot. Curves from previous charts are redrawn and labelled; the total working capital investment and the resulting unit costs, both as functions of lot size. Also, for the sake of fixing our ideas, the minimum cost quantity previously found by inclusion of an assumed commercial interest rate as an element of cost is indicated. The price, as defined earlier is also redrawn.

Annual Rate of Return

The new curve, shown below the earlier curves, represents the annual rate of return on the working capital invested in the lot, as a function of lot size. It is derived as follows. For each point on this curve, we take first the manufacturing profit, or vertical difference between the total "price of lot" curve and the total "cost of sales" curve. This difference, or profit, is then divided by the total cost of sales, or working capital invested. The result is, expressed as a percentage, the profit on the lot. Next, we divide this percentage by the number of years (or fractional parts of a year) represented by the sales period which the lot will provide for. Finally, we recall that our working capital, under the assumption of uniform sales demand, is recovered at a uniform rate; hence the average working capital invested in this particular lot is one half the initial amount.

The rate of return found above must be doubled to obtain the actual return on working capital. Computing enough points to lay out the curve, we then have a picture, under the conditions defined, of the return on working capital investment as a function of lot size.

If we assume that a return on working capital of the amount shown for the previously found minimum-cost quantity (based on the inclusion of interest on working capital as an element of cost) to be satisfactory, we draw a horizontal line to intersect the curve of per cent return. We see at once that this cuts off an intercept, which may be termed the economic range of production quantities for the conditions defined. Every quantity between the points of intersection will yield a better rate of return than the minimum-cost quantity, and a considerably less quantity yields the maximum return. Obviously, any quantity in this range will require a smaller investment of capital than the minimum-cost quantity. Also, very significantly, there is a much smaller quantity shown at the left end of the intercept at which an equally good per cent return on working capital can be earned. This, of course, is because some profit has been sacrificed in order to secure high turnover of working capital in inventory.

Economies of Semi-Finishing

Frequently some study of particular cases reveals methods of conserving working capital to secure even a higher rate of turnover. The case used as the basis for this paper is illustrative of this point. Recalling the cost data, the list of operations was broken into two parts or groups, the first contained most of the operations on which machines must be set up, and the second only one operation on which a set-up charge is incurred. If we make a stopping point for production as illustrated, we could with good advantage bring an entire lot through the first group of operations, spreading the set-up charge over the whole manufacturing lot. We could then finish small quantities out of this semi-finished stock at our convenience. In this way we could permit only a small portion of the lot to accumulate the labor and expense charges required to finish the article. Successive batches could then be sent through to keep reasonably in step with sales demand.

Charts VI and VII illustrate a solution of this case. As shown in the data of chart VI, the lot size manufactured through the first group of operations is chosen at 2,000 pieces. This is then stopped at the end of the first group of operations and a finishing order issued for a batch of 500 pieces. Using the data given, the curves in Chart VI

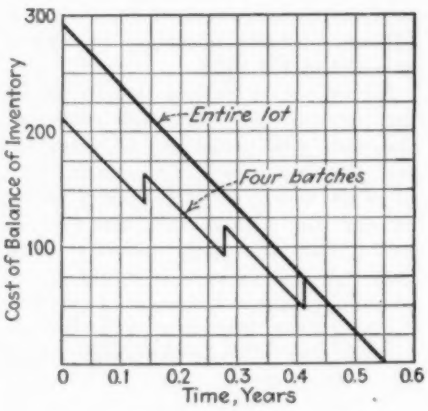


Chart VI—Investment of working capital

Inventory: A—all operations on whole lot completed.
B—order split into four batches after "set-up" operations on whole lot completed.

Sales:	300 per month
Lot Size:	2,000 pieces
Batch Size:	500 pieces

Cost:

A—Entire lot:	
Set-up	$13.44
Process (unit)	0.1386
B—Four batches:	
Group 1:	
Set-up	13.13
Process (unit)	0.0851
Group 2:	
Set-up	0.31
Process (unit)	0.535

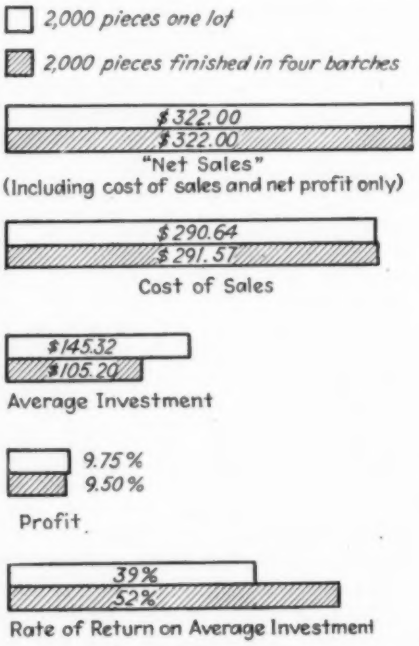


Chart VII—Effect of rate of return on working capital invested in inventory by subdividing the lot into batches following "set-up" operations

result. The sawtooth line represents the balance of cost remaining in the inventory of finished and semi-finished goods. The upper line represents the balance of cost remaining in inventory, as well as the initial investment, for the situation where the entire lot had been run through all operations. The area between the two upper lines represents the release of working capital to other purposes.

The effect of this policy on investment and return can be traced in Chart VII. Starting at the top, the length of bars compares, in order, the net sales, the cost of sales, the average working capital investment, the per cent net profit, and the rate of return on average working capital invested in the inventory. The negligible effect on profit, and the large advantage in capital turnover are apparent.

In Chart VIII we present another side of the story. If we assume that costs remain fixed while net price is driven down, we, of course, know that return suffers. Just what happens and how we may use manufacturing lot sizes to offset partially reduced prices is illustrated in the lower half of the figure.

A scale of prices was assumed, and for each a curve of rate of return on capital invested was plotted, exactly as explained for Chart V.

Two significant things appear: The "break-even" quantity increases rapidly with progressive reduction in price; and the point of maximum return, indicated by the peaks of the successive curves, moves in the direction of larger lot sizes as price is reduced. Capital must be used more and more lavishly to secure a return under these conditions, with the assumption that costs are fixed.

We must recall that up to this point our discussion has concerned itself chiefly with the rate of return on working capital alone and with the amounts of working capital required to produce this rate of return. The correctness of first, emphasizing return on working

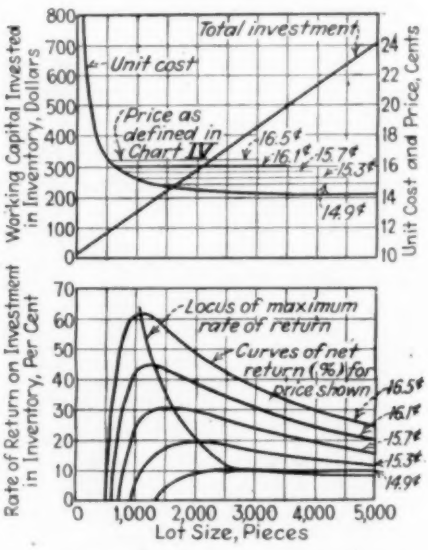


Chart VIII—Rate of return on working capital invested as a function of price and lot size

capital, can hardly be questioned; it is the active part of the investment, fixed assets the static part.

It is only by the application of working capital to the enterprise that any return at all can be made on the fixed investment. Hence, insofar as lot sizes are concerned with the ultimate return to the business, working capital, its amount and the rate of return on it are logical starting points in the analysis. Obviously, also, any analysis is incomplete which stops with only the rate of return on working capital.

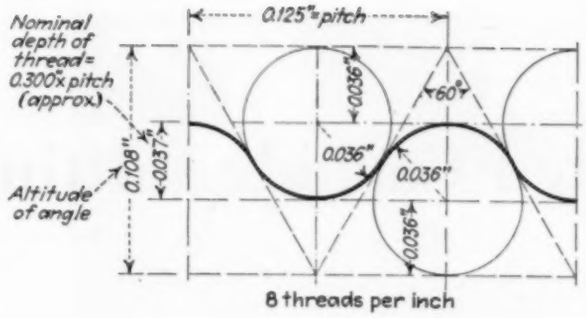
The final judgment of the success or failure of a study and application of determination lot sizes will rest on the effects on earnings of the business on its total investment. This means that not only the rate of return on working capital but the amount of such capital must be considered; these quantities are to be considered not only independently, but also in connection with one another and in connection with the total investment in the enterprise. For example, in the case used as the background of this paper, the quantities at the two ends of the so-called "economic range" were 750 and 3,400 pieces, or roughly, investments of $100 and $480 respectively. On both these amounts, the annual rate of return was the same. Per year, then, the manufacturing and selling transactions in this particular article will yield the business in dollars nearly five times as much if the larger quantity is used rather than the smaller, to apply against the return on total investment.

It should be rather clear that the subject is hardly one which can be reduced safely to a set of rules which can be entrusted to an unskilled operator, like a fully automatic machine. Rather the problem would seem to be one which requires constant executive attention, which will take account of the constantly changing factors of price, competition, costs, sales expectancy, business trends, and finally and most important, the financial condition of the company. The latter will dictate whether a liberal use of working capital may be permitted, or whether its utmost conservation is dictated.

Threads Used in Rolled Sheet Metal

WILLIAM H. BURT

The following formula was not evolved with the idea of securing the maximum depth of thread which can be rolled in sheet metal. It is, however, a form of thread with sufficient engagement to prevent stripping, and one that will work well on all commercial tempers of metal. It is also simple to lay out and easy when it comes to tool replacement.



This shows a method of determining the depth of thread that can easily be rolled and is not likely to strip

As will be seen in the diagram, the thread is laid out by taking the desired pitch and laying out 60 deg. triangles. The circle described in each triangle gives the thread contour by making the circles tangent, giving a continuous line, without angles or flats.

As an example:

Lead of an 8 pitch thread = 0.125
Pitch × 0.577 = Diam. of circle
0.3 × pitch (0.125) = Single depth of thread

This is approximate but accurate enough for sheet metal threads.

The tolerance between mating threads is ¼ of the single thread depth.

This form of thread has proved much more satisfactory than any modification of the V, as the metal can be easily formed to this contour and commercial interchangeability is easily secured.

Tom Johnson Buys Small Tools

JOHN R. GODFREY

"Look at the list of things Tom wants to buy, Godfrey," said Old Man Johnson when I dropped in the other day. He held up a list that would have been startling if the items hadn't been small in themselves. "Tom thinks that if we don't get under cover p d q or sooner, we'll have a lot of work and no tools to do it with."

"Let me tell you the whole story, Uncle John. I've been watching things a darn sight closer than Dad has for some time. We are getting more inquiries, and they sound better. People who were just 'asking' a year ago are sounding like real prospects now.

"So I got to thinking I'd see what would happen if only a couple of the live inquiries turned into orders. And wasn't I shocked when I began to nose into our tool supply? Everybody has been playing so close to the line that we have fewer taps and drills and the like than any respectable shop half our size should have. We've been economizing till our toolcribs look like a relief station after a raid."

"Well, you can always buy taps, Tom. What's the use of tying up money in 'em till you have to?"

"You're kidding yourself, Dad. The dealers and the makers are skinned as close as we are. And it will only take a few rush orders to clean them out. Then where will we be?

"I'm going to play safe and put these orders in now. Then I won't have to ask for rush delivery and upset the schedule of the suppliers. It's up to us, and to all who haven't enough tools to start manufacturing on even a moderate scale, to place our orders now. Waiting until the last minute and then demanding delivery day-before-yesterday won't help business, or employment, half as much as to give the maker a break. Then he can increase his production in a sane and normal manner and stand a chance of making a fair profit."

If more alleged managers would look at things as Tom did in this case there would be a lot less grief in getting business back to normal, and if those who object to the control of industry from Washington will do some real controlling themselves, General Johnson will have an easy job.

Tool Costs—*Discussion*

M. P. DALTON
Sevenoaks, England

John Godfrey (*AM*—Vol. 77, page 26) takes the same attitude as many railway shops and tool steel salesmen, that saving in grinding is a most important item. I cannot agree. In many cases it is cheaper to pay for a fairly complicated organization for grinding and replacing tools, than to buy costly steel simply to save grinding. When the cost of replacement is high, there is obviously something radically wrong with the manner of fixing the tool.

Scheduled replacement also keeps the product within the proper tolerances. This is shown strikingly in the case of press tools. In most shops, they are not replaced soon enough and the tool wears far behind the cutting edge with consequent waste of steel or trouble in assembly.

Cemented Carbide Cutting Tools—II

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and

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In the second part of their article, the authors give the results of original test data from experiments with tungsten carbide used for cutting steel. This, together with the first part of the article which appeared in the last number, will be presented in Chicago during the week of June 26 under the auspices of the A.S.M.E. Metal Cutting Research Committee

THE TOOL BLOCK or holder should be substantial and should provide for supporting the tool as close to the cutting edge as possible. A lathe tool is only a cantilever beam and overhang must be held at a strict minimum if the ill effects consequent to deflection and chatter are to be avoided. Machines designed for carbide tools should naturally have provision for the use of large shanks. The newer semi-production lathes are being equipped with facilities for using a vertical or tangent tool. This is the strongest of all forms of turning and forming tools, and its use should be definitely encouraged.

Work-holding fixtures should be substantial, rigid and quick acting. It should never be forgotten that the high rate of stock removal which is possible with carbide tools necessarily imposes greater loads and strains on tools and tool- and work-holding fixtures than ever was the case with previous cutting materials by a whole order of magnitude.

Cutting Conditions

The factors which influence the selection of the cutting conditions, such as feed, speed and cut, are mainly tool cost or tool life between grinds, the necessary or desired production rate, and the size limits and quality of finish which the tools must leave on the work.

These are questions which each user must, in the last analysis, answer to his own satisfaction. For the sole and declared purpose of being merely a guide or starting point, the cutting data shown in Table I are offered (*AM*—Vol. 77, page 329).

Something should be said in justification of the higher speed regions at which it is recommended that cemented carbide tools be operated. Production is determined only by three factors: feed, speed and cut. It is undoubtedly true that greater power efficiency is obtained when taking thick chips than thin ones and that, in most types of machining, a heavy feed has less tendency to wear away the cutting edge than a light feed. Power is not really so important as many would have us believe.

Cemented carbides, however, free us from some of the limitations so forcibly imposed by high-speed steels. High speed at light feeds—so damaging to high-speed steel tools—does not have nearly as devastating effect on cemented carbides because their outstanding characteristic is superlative resistance to abrasion.

Cemented carbides give us much needed leeway to get good finishes and eliminate chatter. There are for any material cut, critical speeds which produce torn finishes and sometimes chatter (Nickel Steel Bulletin No. 11). With high-speed steels, it is frequently necessary to lower the speed which unfortunately lowers production. With cemented carbides, it is usually possible to raise the speed to get a good finish and yet not sacrifice much tool life.

There is a tendency on the part of some users to expect a little too much of carbide tools. Any increase in production through higher cutting speeds is only possible through a sacrifice in tool life regardless of the material of which the tool is made. Nevertheless carbide tools will cut for suitable periods at far greater speeds than any cutting tool material yet introduced with the single exception of diamond.

Cutting Fluid

Quite often the selection of a proper cutting fluid is the deciding factor in the success or failure of a metal-cutting operation. This subject has only recently begun to receive the careful attention which it so richly deserves.

That the question of cutting fluids cannot be settled by applying the time honored soda water or soluble oil has been clearly demonstrated by recent work on this subject. It is evident that the best fluid must be a good lubricant with high load carrying capacity and good anti-weld-or-seizure properties, as well as a coolant.

For steel cutting, sulfurized mineral oil is finding increasing use. These new fluids not only improve finish and prolong tool life, but also require the expenditure of less power in removing metal at a given rate. Cutting fluids for various materials are listed in Table I.

Preparation of the Cutting Edge

No time spent in the careful preparation of a good cutting edge is wasted. The cutting edge is all by itself—there are clearances under it and rakes all around it. It is in the region of the cutting edge that all of the work of cutting is done. A machine tool is use-

less without cutting tools, and a cutting tool is useless without a good cutting edge. A glance through a 20-power binocular discloses that cutting edges are not always as perfect as the unaided eye would have us believe.

Since many users are now either buying carbide tips only and manufacturing their own tools or are purchasing tools which are merely roughly shaped tips brazed to unfinished shanks, it is desirable to discuss briefly the methods of grinding and lapping tools to keen cutting edges.

Grinding and Lapping

Carbide tools are preferably ground wet. The water or other coolant keeps the carbide cool and flushes away the particles resulting from wheel wear, thus always presenting a clean, free-cutting wheel surface and eliminating the hazard of grinding checks.

A gentle hand pressure only should be used in grinding carbides. Greater pressure does not materially improve the rate of stock removal but does accelerate wheel wear and may cause serious cracking or checking of the tips. The tool should be moved back and forth across the wheel surface and not allowed to remain stationary.

The grinding wheel should run at least 5,000 ft. per min., as below this figure, the cutting action is unsatisfactory. The grinder spindle should be snugly fitted in its bearings and should run true and without vibration. The grinding wheel should be frequently dressed to insure that it runs true and that a glazed surface does not develop. A vibrating wheel or a wheel out of truth will not produce a keen cutting edge and may even chip out small portions of the extreme edge.

Tools should be given a rough grind to get the stock off rapidly without overheating or burnishing with a rather coarse, free-cutting wheel, such as a 60 grit with a soft bond, and a finish grind with an 80, 100 or 120 grit wheel followed preferably by a lapping operation.

Deep grinding scratches or marks in the immediate vicinity of the cutting edge may, in the case of the more brittle grades of carbide, cause premature tool failure through chipping or breaking off of the extreme edge.

Lapping the cutting edges of a tool on a cast iron disk, charged with diamond dust in olive oil or carborundum finishing compound, will invariably prolong the tool life between grinds.

Friction produces wear. A tool with lapped flank and lip surfaces presents little foothold for friction during the early stages of its use in cutting.

Carbide tools can be readily ground on a surface grinder. It is advisable to use a rate of table feed of at least 500 in. per min. as best results seem to be obtained when the duration of contact per stroke of wheel and carbide is at a minimum.

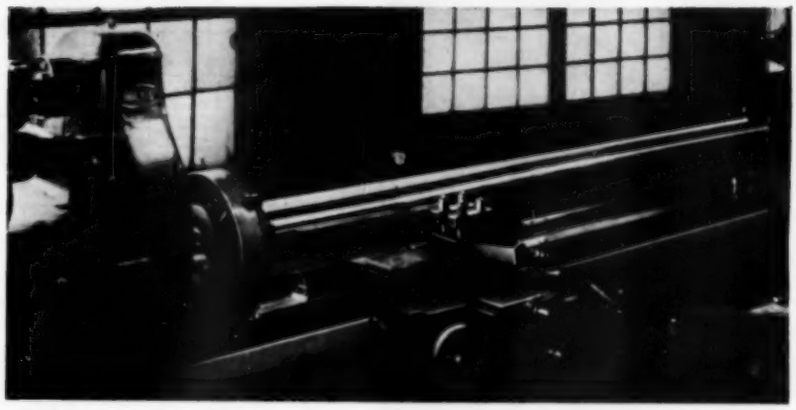


Fig. 7—Carbide cutting tools were tested on steel in a 27-in. 25-hp. engine lathe

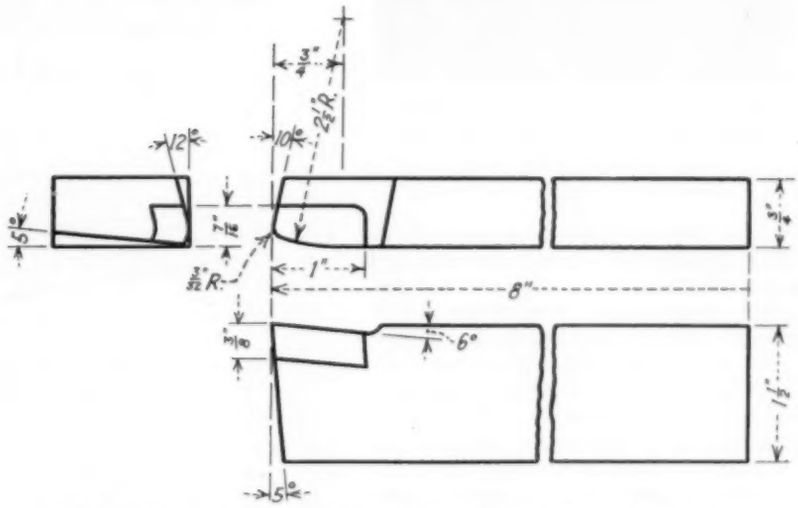


Fig. 8—Shown above are the dimensions and rake angles of the standard tool used in the test

Laboratory Cutting Tests

Since their inception in this country, some four years ago, an imposing array of data regarding the cutting performance of cemented carbide tools has been published. Most of these data refer to outstanding production records made in the shops of individual users under widely varying conditions.

At the June 1930 semi-annual meeting of the A.S.M.E., in Detroit, T. G. Digges presented an excellent paper on the subject of carefully controlled cutting tests of cemented tungsten carbides on 3½ per cent nickel steel. He found that tungsten carbide tools were subject to the same general laws of cutting developed by Taylor and his associates for high-speed steels. The tools which Mr. Digges used in his investigation contained 13 per cent cobalt and were in consequence softer and somewhat tougher than present-day practice would indicate for general purpose cutting on steel.

The present brief laboratory investigation was undertaken in an effort to learn something definite about the behavior of cemented carbide tools containing hard metallic carbides, other than tungsten carbide, which latter does not cut steel satisfactorily.

The 27-in. heavy duty-direct driven engine lathe shown in Fig. 7, was used in the tests. A 25-hp. 4-to-1 d.c. shunt motor was used in driving the lathe. The headstock gearing provided four overlapping speed ranges from 4 to 362 r.p.m. The work speeds were varied through these ranges by a conventional controller, and fine adjustments were obtained through a field rheostat.

The regular dead center was replaced by a live center equipped with ball and roller bearings. This permitted the attainment of cutting speeds up to 1,500 ft. per min. using test logs weighing up to 6,000 lb. without any of the usual center troubles.

Fig. 9—After cutting SAE 1040 steel for 1 hr. 10 min., the tool had a small chip cavity

The form of lathe tool used in the tests is shown in Fig. 8. The side rake was maintained at 12 deg. with a 6-deg. back rake, a $\frac{3}{32}$-in. nose radius and 5-deg. front and side clearance. This is the conventional roughing tool type.

The standard method of testing tools in sequence was generally followed, and the majority of results reported are average values of several individual tests conducted under as nearly identical conditions as possible.

The analyses, approximate heat-treatments and physical properties of the various steels cut are given in Table II.

The tools were set exactly on center at a 90-deg. setting angle with respect to the work axis. The desired feed, cut and peripheral cutting speed were set and the tool fed by hand, until contact was made, when the power feed was engaged and the time recorded. The slowing down of the work under cut was promptly corrected by means of the field rheostat. All cutting speeds were measured with a calibrated cut meter.

Care was taken to preserve a constant depth of cut by testing only on straight turned diameters. Before a freshly ground tool was presented to the work, any glazed surface or embedded carbide particles resulting from the failure of the preceding tool were removed.

All tests were run dry without any means of artificially cooling the tools. Cemented carbides containing tantalum carbide, as mentioned above, will cut steel with less generation of heat than cemented tungsten carbide or high-speed steels.

Although the presence of tantalum carbide materially delays the formation

Table II—Analyses and properties of test pieces used in laboratory cutting tests

TEST LOG NO.	CHEMICAL ANALYSIS								HEAT TREATMENT	B.H.N.	TENSILE STRENGTH THOUSAND P.S.I.	APPROX. S.A.E. RATING
	C	Si	Mn	P	S	Cr	Ni	V				
1	0.43		0.71	0.030	0.036				Normalized by air cooling from 1550° F.	185	93	1040
2	0.61	0.29	0.66	0.036	0.034				Normalized by air cooling from 1650° F.	225	110	1060
3	0.35		0.66	Under 0.040		0.19	3.35		Held @ 1575° F. 18 hours. Furnace cooled. Held @ 1550° F. 6 hours. Water quenched. Held @ 1050° F. 10 hours. Furnace cooled.	250	130	2335
4	1.06	0.70	0.33			18.84	0.24	1.16	Annealed at 1550° F. Furnace Cooled.	235	120	

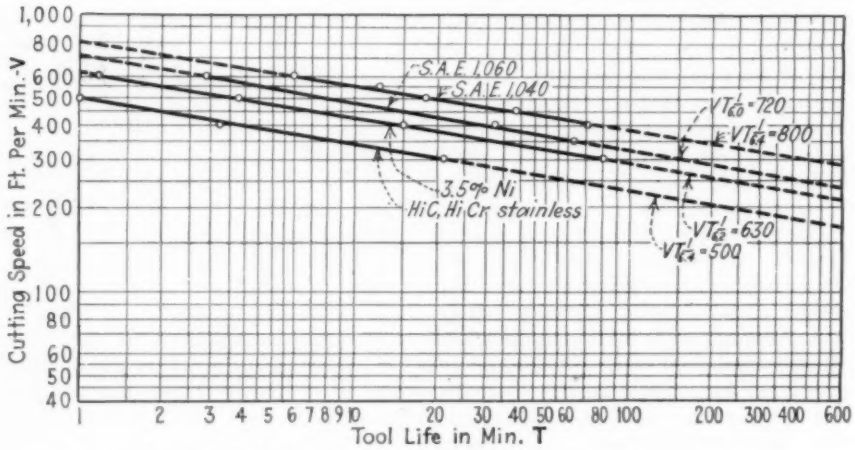


Fig. 10—Cutting speed-tool life relationships of cemented carbide, on the steels designated

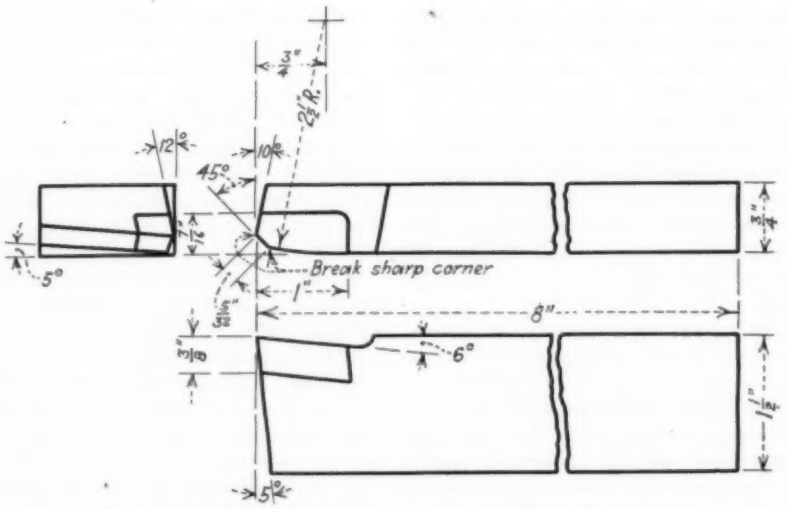


Fig. 11—A tool chamfered as shown was tested to compare its performance with a round nose tool

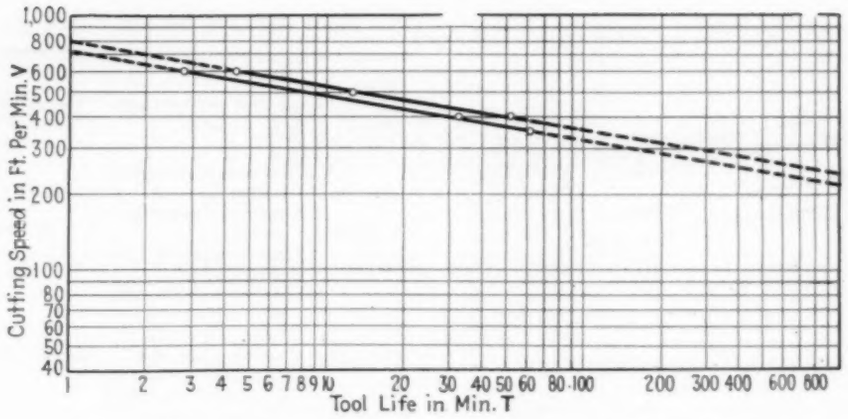


Fig. 12—Relative durabilities of carbide tools with 45-deg. chamfered cutting edges (Fig. 11) and tools ground with a conventional nose radius (Fig. 8): 1/16 in. depth of cut, 0.025-in. feed per rev., steel cut in each case—Test Log 2, SAE 1060

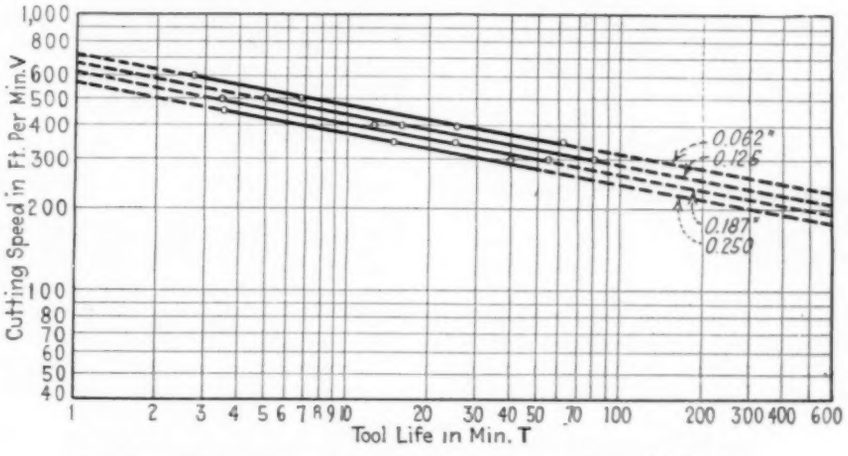


Fig. 14—Effect of varying the depth of cut on the tool life when cutting Test Log 2 at 0.025 in. feed per rev. and the cutting speeds shown

of the familiar chip cavity which forms on the lip surface of cutting tools, such cavities do ultimately form. The appearance of a tool after having cut SAE. 1040 steel (Log. 1) at $\frac{1}{16}$ in. cut, 0.025 in. feed per rev. and 400 ft. per min. for 1 hr. 10 min., is shown in Fig. 9.

Exactly as in the case of other cutting materials, this chip cavity is progressively enlarged as cutting is continued, and the flank of the tool wears, resulting in the rather sudden breaking through of the thin section between the outermost wall of the chip cavity and the flank of the tool. At this point, the power consumed in cutting rises sharply, the log develops a glazed finish, and at the higher cutting speeds, a copious volume of sparks is emitted. This breakdown point was selected as representing tool life in these tests.

Metal cutting tests are notoriously expensive because of the large quantities of costly steels which must be cut up into chips in the quest for reliable quantitative results.

For this reason the depth of cut in Test Series 1 was selected as $\frac{1}{16}$ in. In Fig. 10 are shown the cutting speed—tool life curves for a variety of widely used steels. The tools used were standard Firthite Type T64. The feed per revolution was held constant at 0.025 in.

The equations relating cutting speed V and tool life T of the general form $VT^n = C$ are given for each of the steels cut.

The accusation has been repeatedly made that tests of this sort are rather futile for the reason that the tool life under given conditions varies over such wide limits for the different steels which are in common use that the applicability of such test data is quite limited. It will be seen at once that all of the curves of Fig. 10 are sensibly parallel but vertically displaced.

This family of curves, it is hoped, is but the forerunner of many such which will be developed to add to our knowledge of the relative capabilities of cemented carbides in cutting various

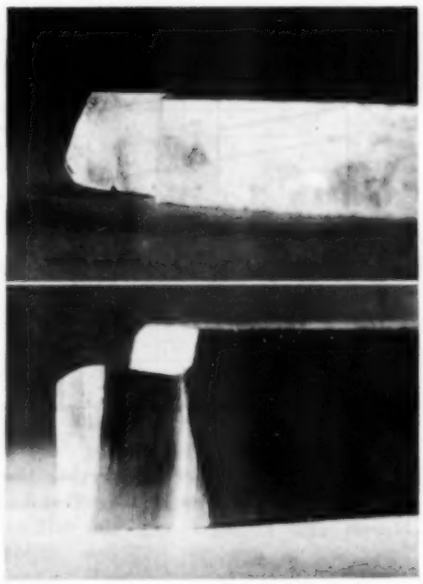


Fig. 13—At the time of failure, the chamfered tool appeared as above

steels. Data of this sort should prove of value to designers and estimators in designing gear ratios and speed ranges of machine tools and in setting time studies which predict possible production rates and machining costs.

It was mentioned earlier in the paper that a tool chamfered at 45 deg., as shown in Fig. 11, would be more durable than a tool with a large nose radius. The test tools used in Series 1 were reground with a $\frac{1}{16}$ in. by 45 deg. chamfered nose instead of the $\frac{1}{16}$ in. radius. Fig. 12 shows that these tools actually cut for materially longer periods than the round nose tools of Series 1 at corresponding cutting speeds. The chips from these chamfered tools are smoother and more compact than chips taken under otherwise identical conditions with round nose tools.

The gain in tool life as shown by the upward displacement of the upper curve is about 60 per cent. The appearance of one of the chamfered tools at tool failure is shown in Fig. 13.

Depth of Cut

The effect of depths of cut of $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in. under a constant feed of 0.025 in. per rev. upon tool life at various speeds is shown in the curves of Fig. 14. These curves, like those for different steels (Fig. 10), are sensibly parallel but vertically displaced. The steel cut in each case was Test Log. 2.

Feed

Using a constant depth of cut of $\frac{1}{16}$ in., the data for Fig. 15 were obtained for feeds of 0.021, 0.025, 0.042 and

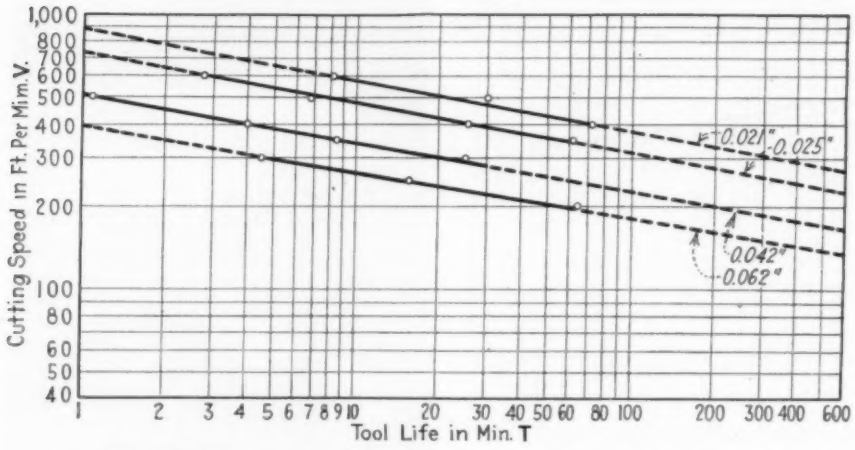


Fig. 15—Effect of varying the amount of feed per rev. on the tool life when cutting Test Log 2 at 1/16 in. depth of cut and the various speeds shown

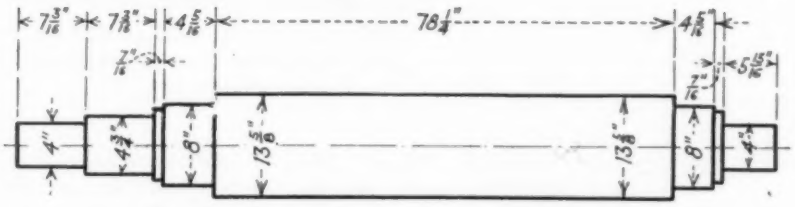


Fig. 17—Three steel printing press rolls were completed with one grind of a carbide tool

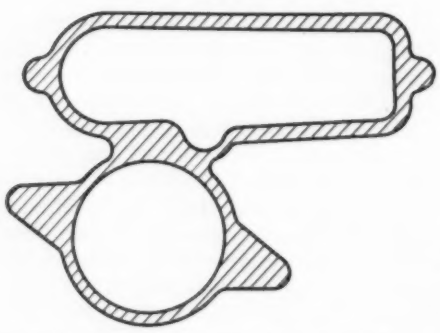


Fig. 16—Carburetor bodies with cross sections as illustrated furnish an example of carbide cutter performance

0.062 in. The parallelism of these curves indicates that tool life is proportional to the feed per revolution if other variables are maintained constant.

The depth of cut and feed curves plainly indicate that relatively large differences in depth of cut produce only small decrements in tool life but that rather small differences in feed per rev. produce relatively large decrements in tool life at corresponding cutting speeds. It is evident that as deep a cut as is practicable should be taken and that only moderate feed rates be employed.

The following selected examples of the use of cemented carbide tools under production conditions in actual practice are included in this report. The list is purposely short and does not embrace by any means all of the classes of cutting in which these tools have so definitely established their superior qualities over previous cutting tool materials.

Face Milling Cast Iron Carburetor Bodies

The outline of the milled surface is shown in Fig. 16. The light section involved resulted in a chilled, easily chipped and fragile work-piece. This set-up in a new K & T duplex milling machine is running almost continuously under the following conditions:

Material cut: Special cast iron — 250 BHN.
Depth of cut: 1/16 in.
Feed per tooth: 0.005 in. per rev.
Cutting speed: 250 ft. per min.
Table feed: 10.5 in. per min.

Average production (six-month period)—8,500 pieces per grind.
Maximum recorded run on one grind — 12,000 pieces per grind.

High-speed steel — 600–900 pieces per grind under greatly slower production rates and cutting speeds.

This application is ideally suited to the use of tungsten carbide. The light, fragile section, the hard iron, the required production and the necessity for a fine finish and flat surface all combine to require the high cutting speed, the extremely fine chip per tooth and the long cutter life which can be realized only through the use of tungsten carbide inserted blade milling cutters.

Form Milling Bronze Parts

High Speed Steel	Cost and performance data	Tungsten Carbide
$80.00	First cost of complete cutter	$525.00
1,000	Number of pieces per grind	20,000
4 hr.	Time required to grind cutter	8 hr.
$610.00	Total cost during life of cutter, overhead, direct labor, set-up time, etc	$1,600.00
0.008 in.	Material removed from each inserted blade per grind	0.004 in.
90,000	Total piece produced during life of cutter	1,250,000
$0.70	Total manufacturing cost per piece	$0.15

End Milling Irregularly Shaped Iron Castings Containing Chilled Areas on Cincinnati Miller

2-in. tungsten carbide shell end mill.
1/32-in. depth of cut to remove scale.

Comparative results:

	1½-in. dia. H.S.S. end mill	2-in. dia. Carbide end mill
Speed	40 ft. per min.	112 ft. per min.
Feed	3½ in. per min.	4⅝ in. per min.
Cut	1/32 in.	1/32 in.
Cost of tool	$3.50 each	$27.00 each
Tool life	6 to 8 consumed per 4-day week.	Used continuously 16 mos.

Multiple Tool Set-up Machining Semisteel Timing Gears

Material — 30 per cent semisteel
Machine — Bullard multaumatic

Comparative results:

	H.S.S.	Carbide
Speed	45 ft. per min.	138 ft. per min.
Feed	0.004–0.010 in. on various tools	0.004–0.022 in. on various tools
Pieces per grind	200–400	1500–2600
Production per day	450 gears	1000 gears
Cost of set-up	.....	$500.00
Estimated monthly saving	.....	$450.00

This set-up has been used for eight months and is less than half worn out. $500.00 worth of carbide tools have saved $450.00 per month at double the previous production rate.

Turning S.A.E. 1050 Printing Press Rolls (Field Test)

Machine — New American 36-in. lathe.
The roll is produced from a rolled shaft. Finished size and shape shown in Fig. 17.

	Roughing Journals	Roughing Body	Finishing Roll
Depth of cut	3/16 in.	3/16 in.	1/16 in.
Feed per rev.	1/32 in.	1/32 in.	1/64 in.
Cutting speed	325 ft. per min.	300 ft. per min.	500 ft. per min.

Requirements: Rolls must be plus or minus 0.001 in. all over. 1½x¾-in. Carbide successfully completed three complete rolls under above conditions on one grind.

Bearings for the Soviets

Part V—How operations at Kaganovitch got under way and with what success

FRANK SCHUBERT

Much of the disappointment caused by failure to live up to production expectations was the result of conditions beyond the control of the directorate of the plant

WITH my luggage at the station, ready to leave Berlin for Moscow, in the middle of July, 1931, telegraphic instructions were received to return to Italy for further discussion of the newly prepared charts for allowances and tolerances. Thus, return to Moscow was delayed until September. Upon arrival in Moscow, I learned that plans for initial productive operations were being laid for January, 1932. While the production departments were not yet under roof, the tool division was ready for machine installation and since it was to be in operation by November, a plan for its initial work was the first thing required. However, nearly every evening for several weeks was given over to conferences with the erection staff, which was having, among other difficulties, trouble in securing supplies and fittings for machine installations. After listening to hours of reports on the reasons for delays in meeting the machine erection schedule, the director briefly but vigorously told the procurement section that while he had heard certain lag screws and bolts and other essentials could not be secured in Moscow, he had not heard of any stoppage in train service to Leningrad or other industrial centers, and that, therefore, he was issuing instructions only in the matter, i.e., to *get* what was needed, *when* it was needed. The tool division began operations in November.

One of the first machines erected was a plain cylindrical grinder built in the "Karl Marx" Russian plant. While its finish was not equal to that of similar machines built in other parts of Europe, it appeared to have been built with good workmanship and the cast iron of the ways appeared better than that of other European-built machines observed by the writer. As before explained, the equipment of the tool division came from a variety of countries, and since the larger groups of machines were built in Russia, others were purchased in quantities too small to warrant the expense of securing demonstrators from the manufacturers' plants. Hence, considerable translation of instruction books was required. Often, it was discovered, after these translations into Russian were completed, that they were so inadequate as to require partial disassembly of the machines before even foreign toolroom workers could feel qualified to operate them.

Small Beginnings

It had been decided that the smallest ball bearings, Nos. E12, E15, and 203 would be the first ones to go into production. The writer cautioned that there were larger sizes which would be more desirable as initial production bearings, because of greater ease of manufacture and larger tolerances. But he was told that, during his absence in Germany, the decision had been reached to utilize the more difficult bearings as the instructive production units. Perhaps, however, the smallest bearings were selected for initial production because possible excessive scrap during the early production or instruction period would result in less loss of material.

The next step was the forecasting of increasing productive efficiency, which forecast was required before the production schedule could be outlined. The desired productive efficiency for each machine, once it was released to production, was 33⅓ per cent in the first month, 66⅔ per cent in the second month, and 100 per cent in the third month. This meant, of course, only two months for the training period. I advised that the analysis of this subject, made some eighteen months before, in America, predicted that with a first month efficiency of 25 per cent, the efficiency increment could not be expected to exceed 60 per cent in the second month, 100 per cent in the third month and 120 per cent in the fourth month. And those were the requirements in reaching productive efficiencies of 25 per cent the first month, 40 per cent the second month, 65 per cent the third month, and 100 per cent the fourth month, or allowing three months for the training period. I stated that I was ready to approve these latter figures, in the light of the urgency with which the bearings were needed, the partial training the first machine operators would have, the enthusiasm with which the personnel seemed willing to attack any problem, and the apparent quality of the supervision available for initial operations. These figures, then, were adopted as the forecast for the first shift, and also for the second shift, with a lag of one month for the latter.

In spite of the fact that these comparatively high machine-operator efficiencies would not meet the ordered production of VATO, one of their planning experts cross-examined me on the subject, fearing error had been made on the high side. He was assured that, given the tools, gages and materials as required, the forecast was deemed to be correct.

From comments on the productivity of the Kaganovitch plant, made in some of the business journals early this year, one would be led to believe that the forecast was in grave error. However, having been in close contact with the problems utterly beyond the control of the directorate, the supervision, and the workers, during those first six months of productive effort, I am not surprised to

learn that, comparing the results of the first quarter of 1933 with those of the last quarter of 1932, the number of sizes of bearings in finished production was doubled and the over-all machine-operator efficiency increased 39 per cent. Of course, the first and the second shifts being of seven hours each, if the proper supervision could be provided a third shift could be used in emergency.

Using this forecast of efficiency increase, the detailed departmental schedules were drawn on the three bearings for the first quarter of 1932, with the next larger sizes beginning initial operations in the same quarter. From this schedule, the equipment and material requirement schedules were drawn up under the supervision of Engineer Ugo Gobbato who had been loaned by the FIAT organization to head the RIV Staff in Moscow.

Some Early Discrepancies

When these requirement schedules were compared with the equipment availability charts some wide discrepancies were discovered. Electric heat treating furnaces probably would not be available until the first month of the second quarter; ball making equipment would not be operating until the third month of the first quarter; presses and dies for separators had not been shipped from Germany and no definite promise could be made as to an exact shipping date; owing to credit conditions in Germany, no orders had been accepted for gages; the main building would not be finished in time for the erection of the automatic screw machines; race grinding wheels would not be available in the small sizes; no steel had been ordered for replaceing the initial five sets of cutting tools ordered with these machines, and these five sets would not be entirely correct when received because of errors in, or insufficient data on the ring drawings; and last, but not least in the minds of some members of the staff, there were no masters or standard rings for setting up the grinding machines or for proving gages.

The RIV staff advised withholding finished bearing production until late March or April. But the pressure of requirements and the enthusiasm of the Russian staff demanded that every effort be made to get the first finished bearings in January. Apart from the normal desire to begin production of finished bearings as originally scheduled, it was apparent that every day without finished bearing production being started meant the loss of a more productive day at the end of the year, and just so many more bearings to be purchased, for gold. Furthermore, to have huge quantities of machines idle because a small percentage of the total was not there meant a wordless indictment for careless management, in the eyes of the people who were making daily sacrifices of the comforts of life in order that such plants as this one might become goods producing units. As a final urge, many workers had been given contracts to report for duty at certain fixed dates. Should they, upon reporting, find no work to do, their wages became a direct over-charge to cost of production, there being no opportunity to place such wages in "deferred charges."

Hence the following steps were taken to overcome the difficulties outlined and to begin finished bearing production in January: Heat treating of the small rings would be accomplished in the outmoded but effective oil-fired furnaces in the factory school (Oochebny Combinaat); balls would be purchased; Russian plants would supply simple single-operation punch presses and the separator dies for such presses would be made in the tool division; gages would be made in the tool division and in the new Instrument Plant in Leningrad; the first two or three automatic screw machines would be set up temporarily in the tool division; large grinding wheels would be dressed down to the required size; surely somewhere in Russia sufficient tool steel could be secured for initial operations, and if the correct ring drawings were rushed to Germany, correct cutting tools could be furnished in time; if master rings were actually required, they could be made in the tool division, or finished in the production grinders as a set-up problem.

On Schedule

Initial operations began on schedule (although the correct corner radii form tools had not yet been received), since in one application the small radii would be satisfactory. The first annealed bars of bearing steel were of an impressively excellent quality, although as was to be expected, when more of it came into use some difficulty with segregated carbides was encountered. This steel originated at Zlatoust, as did the ball wire also, but this wire was finished at the Electric Steel Plant in Moscow. The ball wire also was surprisingly good, but at first some difficulties were experienced with excessive decarburization. Separator sheet steel was supplied by a mill in Leningrad, and although the inspection department held that the majority of it was rejectable, the chief real complaint was an occasional laminated sheet, more trouble being experienced in the storage and proper use of it. At any rate, I was quite relieved that the steel withstood satisfactorily the excessive reduction in area and in thickness and the 90-deg. bends required of it for these first three bearing sizes. The first cutting tools made of Russian steel showed a remarkable increase in production between grinds over the imported tools. The overall experience with these Russian steels was certainly better than that with the two sizes of steel for helical roller bearings, first received from a foreign source.

One of the outstanding successes in getting these bearings into production in the face of the difficulties outlined, was the making of the separator dies for the first bearings No. 203. The separator department staff had broken down the work into practically an hourly schedule, and every man working on the job of design, procurement, or actual die making was scheduled and lived up to it. A bit of difficulty was experienced in the spacing of the locating pins in the piercing die, but this was corrected quickly and the separator department had to fall back upon them after the foreign multiple-position presses and dies were received and the foreign dies failed the second day in use because of poor workmanship.

Official Opening Plans

Despite unbelievable obstacles, the first finished bearings were produced the last week in January, 1932. The inspection or quality control ruled that of these first 80-odd bearings finished, late that evening, only one was "ideal." Yet a foreign observer would have been forced to admit, fairly, that the remainder were certainly as good as similar bearings which Russia was buying elsewhere, and probably as good as 80 per cent of world production bearings of the same size. With these bearings produced and more in sight, it was hoped that the official opening of the plant could be held as planned on January 29. But the director of the heavy industry group ruled that no official acceptance of the plant as a producing unit could be made until the forge shop had at least a few machines in place and operating. Before this ruling was made some 8,000 theater tickets had been distributed to the employees. Hence, at least a gala evening was enjoyed, and perhaps a new impetus to further effort was given the personnel. But it appeared to the writer that the disappointment caused a slight lagging from the pace that had been set in January.

Early in March, it was apparent that the forge shop would be in condition for display purposes and for some production, by the end of the month. So the official "Start" was set for March 29, and this time there was no slip. A platform had been prepared in the turning division, as well as seating capacity

Women workers in the Kaganovitch plant showed more rapid improvement in skill than did the men

for several thousand employees and visitors. About noon of March 29, the ceremonies began with music and continued with speeches by the directorate, the party, the workers, and Engineer Ciocca of the RIV staff; and so the plant was officially accepted.

These ceremonies were followed by an enjoyable dinner, in the hospitable manner in which Russia is schooled. Then came several hours of addresses at the opera (there had been a re-issue of theater tickets), which addresses were not devoid of exhortations to the personnel of the bearing plant to give a good and productive accounting of this excellent plant which the Russian people had "tightened their belts" to acquire. The most impressive address of the evening was given by the brother of the man for whom the plant was named. The only address in a foreign tongue was given in English by the leader of the Chinese Soviet movement, a venerable Chinese gentleman.

During the projecting and the equipping stages of the development of the Kaganovitch plant, the universal question of the majority of the foreign engineers with whom the plant was discussed was, "and after you get this modernly equipped plant, who will operate it?" Others remarked, "The Russian is historically a lazy and slovenly worker; it will take a generation at least to acquire industrial skill." I do not suggest that the reader take my word that it will be a short "generation." With these new and strange devices and machines, the worker, having no old ideas to brush aside, attacks the operating problems with an eagerness that brings surprising results. He studies his machine in his free time, he listens to lectures on machine design and operation, his freedom of expression causes him quickly to pass on his newly acquired knowledge. Illiteracy and suppression of speech have not submerged intelligence. Friends having worked on projects far from Moscow told of machine operators who had no respect for their machines, but this was rarely the case at the Kaganovitch plant where operators actually took pride in keeping their machines clean and in good working order. The department which had excessive machine-down time for repairs found itself socially uncomfortable even among its friends. This social competition among workers, brigades, departments, and even plants is producing results. Then there is nothing but his own efforts to prevent the worker from reaching the higher wage scale brackets in his own or other departments.

Relative Skill of Workers

Regarding the over-all skill of the entire workers' group in the Kaganovitch plant, it is no exaggeration to state that in even an old industrial city, at a time when there is no unemployment, the manning of a quality product plant requiring 4,000 workers for initial operation of modern equipment would produce a cross-section of work-ability of these employees which could not be graded much higher than that produced in the Kaganovitch plant. Some readers will have direct experience with this plant and will state emphatically that such is not the case and can cite individual cases to prove their point. But if one wishes to use the worker case method, one can cite the case of the girl operating the American-built oscillating grinder, who, after two months of intermittent work and instruction, exceeded the guaranteed machine output by 50 per cent over a period of ten days, with a total of three-tenths of one per cent scrap. At this point, it should be noted that as a group the girl operators of machines improved in skill more rapidly than the men operators. Probably this can be explained by the fact that male worker groups have been drained more thoroughly in the higher intelligence brackets. However, it was apparent that the girl operators spent more effort in learning what they were taught to do, and less in attempting to find another way to do it.

Referring again to a business publication's comments on the productivity of this particular plan during 1932; about two months ago some figures were published that only 12 of 35 types of bearings scheduled for production in 1932 were actually produced. Further, that the total production scarcely reached 50 per cent of the scheduled output. Actually there were only 29 sizes on schedule to be produced on equipment either in the plant or purchased, and four of these sizes were withdrawn from production before they were fairly started. Supplementing the published statement that 50 sizes are scheduled for 1933 production, it is noted that 24 of these were in finished production at the end of the first quarter of 1933. In the writer's knowledge of actual conditions this apparent failure of the worker in the Kaganovitch plant to advance in skill within a wide margin from the forecast, is not correctly analyzed as such, for far greater and immediate obstacles were the preponderant causes of this set-back.

In June, 1932, the schedule for the balance of the year was drawn. September schedule called for bearings to be produced on the basis of equipment and materials on order as well as actually available. This was rightly the normal method on a new project, since it was then a spur to every man or bureau concerned with the procurement or the production of such equipment and materials to do better than was apparently possible. To the writer, in June, it was apparent that much of the equipment, at least, would not be available in time to begin initial operations assuring all the scheduled finished bearings in September. Exactly how much of it was available, I do not know, but I learned with considerable surprise that the schedule was 50 per cent fulfilled.

The reader may be assured that the reported production consisted of bearings made to a high standard of quality. Foreign machine observers and demonstrators were complaining of the superquality requirements maintained by the Kaganovitch inspection department, as recently as the first quarter of 1933. Rejections included parts and bearings which would surpass in quality those Russia could buy in the open market.

Many Russian technicians have held the idea that Russia must do things better than they are done elsewhere. Unfortunately, these technicians seem to have gravitated to the various inspection departments, almost as a group. Perhaps there is room for improvement in the quality of anti-friction bearings, but it is not all dimensional and though it were, Russia would be paying a terrific price for attempting to accomplish it during the first year of operation. The majority of the engineering staff did not see eye to eye with me on this subject, which was the topic of discussion in the last conference attended in Moscow. Their opinion was that if lower standards were used, the scrap loss would be just the same, based on the worker experience or lack of it. I could scarcely refute their acquired experience with their own worker-psychology, but the opinion was not soundly based. They were overlooking the fact that, given the most highly skilled bearing operators in the world, it is scarcely safe to fix a minimum quality limit so near to the marginal productive accuracy-ability of the machines in use, and that is what they were doing. But such a basic question could not be answered in one conference, although the Directorate was inclined with the writer, as opposed to the technical and the Italian staffs. Time alone will bring the proof.

(Fifth and last article of a series. The others appeared respectively in Vol. 77, pages 229, 273, 296 and 334.)

False Jaws for Vises

D. W. PATTON

Many vises having false jaws of hardened steel are made by toolmakers and machinists. However, these false jaws are generally smooth and lack the gripping surfaces of checkered jaws.

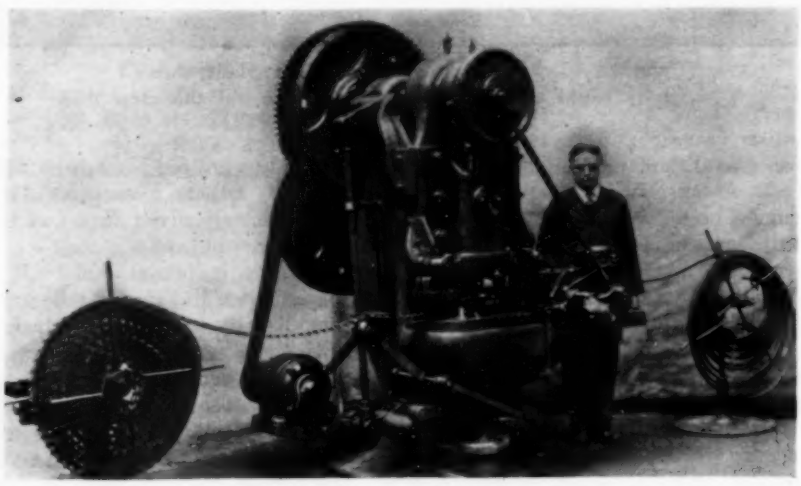
For rough work, false jaws that will grip the work can be made from an old file. Anneal the file and cut out the pieces wanted with a hacksaw. File to size and drill and countersink for the holding screws. Then reharden and draw the temper to just below the brittle stage. The file teeth make excellent gripping surfaces for rough castings that would otherwise ruin the surfaces of smooth jaws.

One Pass Through the Press Cuts the Cost of Chain

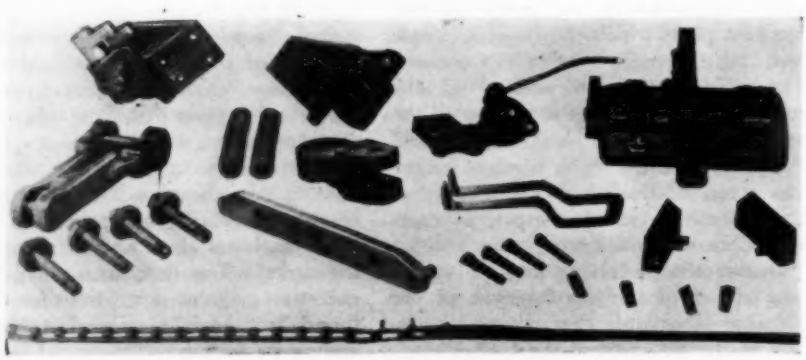
Facing the task of making an agricultural chain to meet an unusually low estimate, a manufacturer turned to the engineers of the Ferracute Machine Company. The arrangement illustrated was the result. A special heavy duty press was used with progressive dies which converted automatically fed $\frac{3}{8}$ x $1\frac{3}{8}$-in. strip steel into finished chain at the rate of 40 links per min. The press weighs about 10,000 lb. and is driven by a 5-hp. motor through a belt.

Seven operations are required to complete the chain:

1. Score sides V-shaped, top and bottom.
2. Score end of hole, top and bottom, with a V-shaped punch.
3. Lance end.
4. Partially form or curl metal lanced in the previous operation.
5. Form end of link and score V-shaped, top and bottom; also form further.
6. Break scoring at the end of the link.
7. Finish curl, locking the chain links together.



Strip steel is fed from one side; chain comes out the other. There is no waste



Dies for chain making are shown with a strip in the process of conversion

EDITORIALS

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EDITORS

Change the Labor Clause

In our editorial of two weeks ago we remarked that the labor or employment section in the President's "National Industrial Recovery Act" needed clarification. The House has clarified it.

As it now reads, this section outlaws the company union specifically but places no restriction on the establishment of a closed shop in any industry. President Green of the American Federation of Labor interprets the revised phrasing of the section as an invitation to the organization of all industry. His leaders met yesterday to plan their campaign.

If the bill becomes law with this section unchanged we predict that it will have difficulty in living up to its designation as a "recovery" measure. Organized labor leadership has changed little since the World War, as recent events have proved. Restriction of output and resistance to the introduction of labor-saving machinery are as definite policies as ever. If you question this statement ask exhibitors at the Chicago world's fair to tell you of their experiences with the unions there.

Sunk by Junk

Here is a machine-tool salesman's report that tells in the casual language of trade a story of ignorance and inexperience, tragic to the victim but all too common in a laissez faire economy such as ours.

"Customer is having a tough time with the mess of old equipment he purchased to start with, but consoles himself by saying he 'done' the best he could with the limited capital he had. Says he learned his lesson and will buy new equipment if he can hang on long enough to get the money to do so."

When he goes under, as he probably will, the epitaph on his business tombstone might well be "Sunk by Junk."

How Practical Are Practical Men?

Those of us who pride ourselves on being graduates of the school of hard knocks, who still cling to the idea that we are thoroughly practical, may well ponder the words of Dr. Robert Hutchins of the University of Chicago in a recent address. "As has been amply demonstrated in recent years," he says, "practical men are those who practice the errors of their forefathers. The professor, who is sometimes right, studies the practices of practical men. If he wishes to stay right, he doesn't practice them. The reason why few sound economists will today venture a prediction as to the results of the government's inflationary program is that its consequences depend on the mass psychology of business men.

"The professor is sometimes right because his sole desire is to be right; he has no axes to grind, he can pursue the truth for its own sake, and he is secure in his job no matter what his views.

"The professor is very likely to be wrong, however, when it comes to educational matters in which he has vested interests, personal ambitions and ancient habits which he wishes to protect, consciously or otherwise."

There is sound meat for us all in these remarks. Few of us are able to put aside personal ambitions or desires sufficiently to give ourselves a true picture of any problem in our line. And now is the time we need true pictures and unbiased suggestions. With all deference to the wisdom of our forefathers, we must remember that we are facing problems far different from theirs in many ways. The way to be really practical today is to refuse to be hampered by practices of the past.

Forcing a New Deal in Management

The mental processes behind some of the ways of doing business are among the great wonders of the world. The idea that every competitor is an enemy to be defeated at all costs seems hardly in keeping with modern ethics or business. One of the worst examples is where a manager whose concern has never built a certain type of machine blindly underbids, by a huge percentage, those who have had wide experience with the product. Such actions often hurt a whole industry, waste capital and cause losses to many.

The endeavor to prevent business going to another line is also responsible for estimates made on far too close a margin. In one instance the bid was so close that the extra cost of the metal in a tube that was only a thousandth of an inch thicker than estimated wiped out all hope of profit on the job. In this particular case the competitor who lost the job would have made a fair profit as he refuses to play the cut-throat game. The foolishly close bidder not only made no profit himself but he prevented another concern making a profit. He also encouraged the buyer to hammer prices below a fair level on the next order.

Chiseling by buyers is bad enough but it is even worse for the producer to help them continue the practice. A new deal that compels manufacturers to make a profit or quit will be a benefit to all concerned. This will not prevent improved methods and lowered

costs. It will, however, compel an accounting that shows a real profit or close up the losing venture that is a menace to all sound business enterprises.

Repair Work—Who Should Do It?

A New England subscriber raises this question which is worth discussing at any time, but particularly so just now when manufacturers in every line are starting to put their production machinery in good shape for anticipated orders, or for ones actually on the books. Should the textile mills, the shoe factories, the printing establishments, and other plants outside the metal-working industries maintain repair machine shops of their own, or should they contract this work out to the small machine shops in their immediate neighborhood? Which of these two types of shops is best equipped and manned for such work? Which is likely to be able to operate with the lower overhead? Which will be better acquainted with modern shop practice? How important is it to maintain emergency repair facilities for breakdowns under present operating conditions?

We shall welcome discussion on any or all of the phases of the main question which we have suggested.

• CHIPS •

House passes industry control and public works bill, administration narrowly escaping defeat on increased income tax provision . . . Hearings before Senate committee promise more thoughtful consideration . . . Electricity tax transferred to producers, President given power to change mail rates . . . Senate passes amended railroad control bill . . . Large part of public works fund to be used to aid cities . . . Securities Control Bill, applying to new issues only, signed . . . President modifies naval economy order to preserve battle fleet strength . . . Surplus personnel to be assigned to reforestation corps and other civil services . . . Same arrangement likely for army officers . . . Administration insists prohibition repeal is only alternative to increased income taxes . . . Conferees agree on Glass banking revision bill including deposit guaranty.

U. S. abandons isolation policy as Davis renounces neutral rights . . . Russians buy foreign wheat to avert famine comparable to that of 1921 . . . Herriot tells French deputies that Roosevelt insists on December debt payment before opening negotiations . . . Japanese troops enter Peiping . . . Chinese generals accused of selling out . . . Truce signed looking to evacuation of zone south of Great Wall by both armies . . . Civil warfare starts in China . . . Henry L. Stimson accepts chairmanship of permanent Franco-German arbitration commission.

Federal Reserve Board, on orders from the President, starts to buy $25,000,000 of government securities in resumption of open market activities . . . Dr. O. M. W. Sprague, former economic adviser to Bank of England, expert on managed currency, added to staff of Secretary Woodin . . . Senate committee examines Morgan and his partners . . . Believe it or not, some members of Congress profess astonishment at learning that rich men do not pay income taxes in depression years . . . Kuhn, Loeb and Dillon, Read next in line . . . Stock Exchange bars listing of Allied Chemical & Dye on refusal to give facts to stockholders . . . House passes bill to end gold clause restriction thus putting U. S. officially off gold standard . . . Federal Reserve Banks of N. Y. and Chicago lower rediscount rate, N. Y. to 2½ per cent, Chicago to 3 . . . R.F.C. warns railroads to cut high salaries if they want loans.

Union Pacific places order with Pullman for 110-m.p.h. streamlined, articulated, diesel-electric, light weight train . . . DuPont acquires voting control of Remington Arms . . . Pennsylvania orders 23,500 tons of rails . . . North American Aviation, General Motors subsidiary, acquires control of Western Air Express . . . Drug, woolen and other industry groups organize for operation under new industrial control plan . . . Gen. Johnson moves to Washington and starts building organization to administer industrial control bill . . . Green, A. F. of L. leader, summons cohorts to Washington to unionize the country . . . Industrial leaders protest labor section in control bill . . . Allis-Chalmers takes $100,000 federal tractor order . . . Means work for 350 men . . . Pullman gets order for 500 steel box cars from Chicago Great Western, more than were ordered by all roads in 1932 . . . General Motors plants raise wages 5 per cent.

Chicago Century of Progress exposition opens . . . Secretary Wallace appoints ex-Senator Brookhart his farm agent to negotiate with Soviet authorities for Russian market for surplus American wheat . . . U. S. delegation leaves for World Economic Conference in London hoping for lowering of trade barriers but prepared to take stand for domestic self-sufficiency if necessary . . . Wholesale prices rose over four per cent in May . . . Amtorg officials received at Washington to discuss barter and trade arrangements . . . China gets $50,000,000 loan to buy wheat and cotton.

Steel production continues to increase, approaching 50 per cent . . . Passes 1931 record for first time . . . Tin plate mills in some districts at capacity . . . Car loadings ahead of 1932 . . . Electric power production continues rise above last year's figures . . . Rate last week nearly five per cent ahead of 1932 figure . . . Copper rises to 8 cents, lead to 4.10, zinc to 4.325 . . . Business Week index of general business rises strongly above last year's corresponding figure.

Industry Bill Under Fire

Full realization of the implications of the Industrial Recovery and Control Bill has aroused the direct opposition of several business groups. Chief bones of contention are the labor and tax clauses although other parts of the measure have also drawn the fire of industrial leaders.

In its last number, *American Machinist* reported in full the Text of Title I of the Bill (*AM*—Vol. 77, page 340c) and pointed out editorially that the labor clause was extremely vague. The House amended the Bill to remove this vagueness but in doing so bowed to the suggestions of William Green, president of the American Federation of Labor. As first written, the clause might have been construed to give the worker freedom of choice to join or not to join either a company or an organized labor union. As rewritten this provision clearly sponsors the outside organized union as against the company union, thus implying government backing of the labor organizer. The labor section as it now stands reads:

Sec. 7. (a) Every code of fair competition, agreement, and license approved, prescribed, or issued under this title shall contain the following conditions: (1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organizations or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; (2) that no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining a labor organization of his own choosing; and (3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other working conditions, approved or prescribed by the President.

Aroused to the need of combatting this and other clauses before the measure becomes law, the National Association of Manufacturers met on June 3 in Washington and stated that the labor provisions had no place in the legislation but if retained should be worded so as to operate equally upon both employers and employees. Other amendments urged were to give the President the power to deal with imports that would otherwise result from increased costs of domestic production, to eliminate objectionable features of the license section which is declared unnecessary, objectionable and probably unconstitutional, to set up a representative advisory committee to interpret practical needs of industry rather than a single administrator and to substitute a general sales tax for the higher income and other special taxes specified in the Bill.

While expressing sympathy with the objectives of the plan, the Manufacturers Association stated that in its present form the Bill is unworkable and as such would tend to disturb industry and retard business recovery and employment.

These same points are also attacked by the National Metal Trades Association which believes that the measure, if passed as emergency legislation, may become a permanent policy. This group also fears that organized labor will take this opportunity to start a drive against the open shop by unionizing all lines of business. It is claimed that such action would scrap the fundamental freedom of business and force all industry to travel the path on which the railroads now find themselves.

This intention was approved by Mr. Green in calling labor leaders to a meeting in Washington on June 6. In announcing this meeting, Mr. Green stated that labor must share the benefits of the Bill and and emphasized the need of furthering the principle of collective bargaining. He recommended the launching of a campaign to organize unorganized workers so that they "may participate in the benefits of the Bill and demand that employers negotiate with their chosen representatives."

Originally expressing its accord with the provisions and objectives of the Recovery and Control Bill, the Chamber of Commerce of the U. S., through its president, Henry I. Harriman, has also raised objections to certain clauses. In a letter to Senator Pat Harrison, Mr. Harriman urged changes in the labor sections so the "principles of true open shop operation are not contravened."

Many observers are deploring the injection of the capital-labor feud into the bill, asserting that this controversy may do much to neutralize the prime objectives of promoting recovery and reemployment. They believe that the labor provisions are out of place in the bill and that their deletion would make the other sections more effective.

• INDUSTRIAL REVIEW •

Even the machinery and equipment industries are beginning to feel the effects of the stimulus of industrial revival. Supply business in May ran as much as fifty per cent ahead of previous months in several centers. Machine tool business still lags but other machinery builders are busy on repair orders and an encouraging amount of new business. There is a growing demand for good used machine tools.

New York reports a few orders and an increase in inquiries. May was a better month for some dealers but the latter half was not so good as the beginning. New England reports a tendency for customers to delay in closing but looks for good business in the fall. In Philadelphia shops are busier and inquiries for equipment are better, but orders are as scarce as ever.

Pittsburgh machinery men are encouraged not only by the spurt in steel but also by a strong increase in inquiries and a few real orders. Supply business has picked up. Cleveland has noticed a general improvement but is inclined to be cautious in acclaiming it as a genuine boom. Detroit is naturally feeling better as activity increases in automobile plants and prospects for its continuance brighten. Supply business is much better but few machine tool orders have been placed and but few are expected before autumn.

In Cincinnati they seem to feel that the jam has been broken and that the future is much brighter. Little volume business is expected before fall but there is current interest in used tools. A few new orders have come in. Indianapolis reports much the same situation. St. Louis supply business jumped nearly fifty per cent in May. Some companies advanced wages but others are stalled by lack of capital and reluctance of banks to loan. A few machine tool orders were placed.

Chicago is feeling the stimulating effect of the successful opening of the Century of Progress. Few machine tool orders have been taken but there is a keen interest in used machines and prospects for September business in new equipment are considered excellent. Metal-working companies in Milwaukee have received substantial orders and have added to payrolls and employment. Little machine tool business has come in.

Suggested Action for Trade Groups if the Industrial Recovery and Control Bill is Passed

I. Directors should appoint two committees:

a. To review and if necessary to revise constitution and by-laws in order to qualify their association as truly representative of the industry.

b. To draft a code and agreement observing restrictions and purposes of the bill. This agreement might cover:

1. Employment—hours, wages, putting men to work, and employee insurance.

2. Cost—uniform accounting, labor, freight, overhead, depreciation, obsolescence.

3. Competition—exchange of information, prices, unethical practices, cutthroat methods.

4. Production — capacity factors, yardsticks of comparison, quotas.

II. Committee findings to be reported to Board of Directors which in turn will offer them to the membership for amendment or approval.

III. Code to be presented in accordance with the machinery set up by the appointed Presidential administrator.

IV. Upon acceptance and approval of the code, the designation of an enforcement committee to apprehend and report offenders under provisions of the Act would be in order.

V. Code should be reviewed periodically and modified to meet changed conditions if found necessary.

Meanwhile trade groups representing specific divisions of industry, believing that passage of the Bill in some form is probable, are preparing programs in anticipation of its enactment. Those industries having no central organizations are taking steps to set them up. The two billion dollar drug industry, for example, has formed the Drug Institute and has appointed Wheeler Sammons as acting managing director. The purposes of this organization are given as the maintenance of fair wages, the elimination of uneconomic competition and the protection of the purchasing public.

Other industries are reorganizing their trade associations so that they may qualify as truly representative according to the terms of the Act. This involves changes in constitutions and by-laws to remove any inequitable restrictions to membership and to revise their internal machinery to permit quick action. The Steel Founders Society of America is an example of this group as it has divested itself of all social and honorary aspects to become a practical working unit under the pending legislation. Col. M. G. Baker has been made executive vice-president of the Society and has already formulated tentative plans for a code for this branch of the steel industry.

Two tentative codes were offered at the annual meeting of the National Electrical Manufacturers Association held at Hot Springs, Va., in May. One plan submitted by a committee headed by Francis E. Nagle contains no specific provisions but simply enumerates certain regulations, policies of operation and administrative procedure which might be necessary if the control measure is placed upon the statute books. Another plan submitted by Gerard Swope, of the General Electric Co., contained more detailed proposals as to working hours, wages, pensions, and employee insurance of various kinds.

Neither plan presented before NEMA was accepted; the only action taken was to authorize the board of directors to function as might be required under the new act. This association in common with most others is withholding specific commitments in order to avoid seeming to indorse a plan which it disapproves in part at least. It is felt that premature release of the plans would be out of order in the absence of procedure specified by the appointed administrator.

Many other industrial organizations are closely watching the progress of this legislation and are revising or formulating codes of ethics in accordance with the Bill. Among the fifty associations already formulating programs are the National Machine Tool Builders Association, the Iron and Steel Institute, the Pressed Metal Institute, the Cotton-Textile Institute, the Silk Association of America, the American Knitwear Manufacturers Association, the National Association of Hosiery Manufacturers, the Industrial Council of Cloak and Suit Manufacturers, the Merchants Ladies Garment Association, practically all the subdivisions of the Pulp and Paper Manufacturers Association, the National Canners Association, the National Preserves Association, the Associated Grocery Manufacturers of America, the American Oil Burner Institute, the Manufacturing Chemists Association, the Associated General Contractors of America, the American Institute of Steel Construction, the National Lumber Manufacturers Association and the Retail Tobacconists Association.

Students of the Recovery and Control Bill are practically unanimous in admitting that the effect on industry will depend on how and by whom the authority thus set up is administered. Gen. Hugh S. Johnson is, of course, slated for the job and while admitting his qualifications, few will venture a guess as to how far he will go toward the regimentation of industry.

It is evident, however, that the better business gets the less stomach its leaders have for the rigid control within the scope of the Bill. Two months ago any action was deemed better than stagnation, but with business making new strides each week, the desire for freedom from regulation has returned.

Implement Exports Higher Than in 1932

According to a Department of Commerce report, exporters of farm implements transacted more business in April than a year ago but less than during March. April exports were valued at $918,125 as against $861,880 in April 1932 and $1,215,530 in March 1933.

Gains were reported in shipments of cream separators, harrows, cultivators, harvesters and binders, combines and towers and parts of windmills. The decline from March was caused by smaller shipments of tractors, tractor parts, tillage implements and threshers.

Canada was the largest foreign buyer for April taking about 16 per cent of the total.

Clamer Honored by Foundrymen

Guilliam H. Clamer was awarded the Joseph S. Seaman medal by the American Foundrymen's Association for outstanding achievements in metal casting. Presentation will be made on June 22 during the 1933 annual A.F.A. convention at Chicago.

Mr. Clamer graduated from the University of Pennsylvania in 1897 and established a chemical laboratory at the Ajax Metal Co. with which concern he has been associated ever since. He has been instrumental in developing numerous high strength special steels and other alloys for many types of service requirements. For the invention of a new refining process, he was awarded the Elliott Cresson Gold Medal by the Franklin Institute in 1901.

Mr. Clamer is a past president of the American Foundrymen's Association, the American Society for Testing Materials, the American Institute of Metals

Exports of Machinery During April, 1933

	April, 1933	March, 1933	April, 1932
Electrical machinery	$2,877,063	$2,732,276	$4,244,302
Power generating machinery (except electric and automotive)	239,648	263,648	379,876
Construction machinery	276,876	174,404	233,056
Mining, well and pumping equipment	801,005	955,292	849,541
Power driven metal-working machinery	554,427	681,914	1,118,110
Other metal-working machinery	131,479	99,946	197,692
Textile machinery	330,432	302,274	365,363

Exports of Metal-Working Machinery During April, 1933

	April, 1933	March, 1933	April, 1932
Engine lathes	$3,470	$33,570	$22,987
Turret Lathes	6,407	758	11,945
Other lathes	279	9,912	3,326
Vertical boring mills	2,265	8,578	12,349
Thread-cutting and automatic screw machines	19,547	41,723	35,390
Knee and colume type milling machines	200	37,020	15,086
Other milling machines	15,461	75,104	61,056
Gear cutting machines	25,236	64,538	41,200
Radial drilling machines	530	.....	.....
Vertical cutting machines	5,801	2,204	18,146
Other drilling machines	24,451	10,652	118,309
Planers and shapers	26,794	2,150	7,575
Surface grinding machines	650	15,146	6,235
External grinding machines	1,034	3,474	7,776
Internal grinding machines	850	11,071	15,738
Tool grinding, cutter grinding and universal grinding machines	5,152	11,737	14,283
Other metal grinding machines	12,051	17,611	47,668
Sheet and plate metal working machines	65,008	93,191	243,921
Forging machinery	18,839	54,357	71,273
Rolling mill machinery	17,565	4,052	192,521
Foundry and molding equipment	145,658	15,737	18,514
Other power driven metal-working machinery and parts	157,179	169,330	152,812

Other Metal-Working Machinery

Pneumatic portable tools	27,736	13,381	35,834
Other portable hand operated machines and parts	22,876	25,393	33,005
Chucks for machine tools	4,077	2,793	3,179
Machine operated pipe and thread cutters, stocks, dies, taps and other machine operated cutting tools	49,195	30,609	73,795
Other metal-working machine tools	27,595	37,769	51,879

and the Mining and Metallurgical section of the Franklin Institute. In addition to his connection with the Ajax Metal Co. he is president and general manager of the Ajax Electric Furnace Corporation, the Ajax Electrothermic Corporation and the Ajax Electric Co. On June 5, he received the honorary degree of Doctor of Science from Ursinus College.

Carpenter Becomes Houghton Manager

At a recent meeting of the board of directors, Major A. E. Carpenter, first vice-president of the E. F. Houghton Co., of Philadelphia, was elected general manager having resigned as treasurer. Louis E. Murphy continues as president.

George W. Pressell, second vice-president, resigned as secretary to become assistant general manager and director of sales. Dr. R. H. Patch was elected treasurer, and A. E. Carpenter III was made secretary.

George S. Rogers, formerly assistant sales manager in charge of the St. Louis and Chicago offices, becomes general sales manager with headquarters at Philadelphia. Sales for May, 1933 were reported to be the highest in over a year and 24.5 per cent above those of the same month in 1932.

Japanese Metal Industries Active

Japanese plants engaged in work for the Army and Navy are continuing to install machinery and electrical equipment. Local manufacturers and well established American firms are benefited by this demand. This activity will continue for the next six months according to an estimate of the Department of Commerce.

It is reported that the government has authorized taking over the Anshan operations in Manchuria by the newly formed Showa Steel Works. A new plant is to be built at Anshan to produce pig iron, steel ingots, bars and various other steel materials. Prices continue to remain satisfactory except for pig iron which has not improved as much as other iron and steel products.

Service Tools Associates Protest Shows

Characterizing the holding of two separate shows by the National Standard Parts Association and the Motor Equipment Manufacturers Association as unnecessary and an unwarranted expense, the Service Tools Associates sent a resolution of disapproval to the presidents and secretaries of both associations. A poll of the members resulted in an opinion that no show should be held this year, but that if any were held, it should be under the joint auspices of M.E.M.A. and N.S.P.A.

British Exhibit in September

The Twelfth Shipping, Engineering and Machinery Exhibition at Olympia, London, has been scheduled this year for September 7 to 23. About 60 official visits will take place during the exhibition, invitations for which will be issued to members of societies who are habitually entertained.

International Institute Plans Tour

A study tour through the United States is planned for this fall by the International Management Institute which has its headquarters at Geneva. Subscribers will leave Europe on October 4 and will be in this country from October 13 to November 2. The itinerary will take in eight cities and cover three classes of visits: institutions and trade activities, industrial and commercial enterprises, and sight-seeing.

The purpose of the tour is to facilitate the study of modern methods of management. Among the commercial and industrial visits will be those to two automobile factories, a cash register plant, a machine tool plant, a steel foundry, a shoe factory, a glass works, a power plant and a publishing house.

Feiker to Make Textile Survey

Frederick M. Feiker, for the past two years director of the Bureau of Foreign and Domestic Commerce, has been engaged by the Textile Foundation to make a study of educational programs in the textile industry. It is stated by one authority that only one school in the country offers a graduate course in cotton technology.

Mr. Feiker was formerly engaged in editorial work with the McGraw-Hill Publishing Co. where he took a leading part in the establishment of the papers, *Factory*, *Electrical Merchandising*, and *Ingenieria Internacional*. In 1921, Mr. Feiker was given a leave of absence from McGraw-Hill to organize the commodity division of the Bureau of Foreign and Domestic Commerce.

Forged Tool Standard Reaffirmed

The Simplified Practice Recommendation R17-31 on "Forged Tools" has been reaffirmed by the standing committee without change. The committee's action was unanimous, according to the Bureau of Standards, Department of Commerce, Washington.

• PERSONALS •

F. G. MORLEY has been elected president of the Great Lakes Engineering Works, Detroit, to succeed the late J. A. UBSDELL. GEORGE B. TURNBULL has been appointed general manager.

JOHN E. COTTER, secretary to E. P. BULLARD, president of the Bullard Co., Bridgeport, Conn., was named assistant secretary and treasurer at a recent meeting of the board of directors. Mr. Cotter has been with the company for the past sixteen years.

ROBERT M. EAMES, general manager. of the Bryant Electric Co., Bridgeport, Conn., has been elected vice-president. He will retain his position as general manager, which he has held since 1930.

F. A. MERRICK, president of the Westinghouse Electric & Mfg. Co., was elected a director of the National Association of Manufacturers.

• BUSINESS ITEMS

The E. W. Bliss Co. has completed plans to consolidate its manufacturing, engineering and principal sales offices with those of its subsidiary, the Toledo Machine & Tool Co., Toledo, Ohio. The entire line of presses, can machinery and special machinery formerly built at the Brooklyn, N. Y., plant will be manufactured at Toledo. A sales office and complete repair shop will be maintained, however, at the present Brooklyn address, 53rd St. and 1st Ave.

The Continental Tool Division, Ex-Cell-O Aircraft & Tool Corp., Detroit, has been moved from 5835 Martin Ave. to the corporation's main plant, and the address is now 1220 Oakman Blvd. Centralization of activities of the Continental Division is expected to promote better service on the cutting tools manufactured.

The Allsteel Press Co., 12015 S. Peoria St., Chicago, Ill., manufacturer of the "Verson" line of welded steel presses and sheet metal-working machinery, has appointed LEONARD R. NOURIE, Park Bldg., Pittsburgh, as representative in that district.

The purchasing department of the Caldwell-Moore plant, Link-Belt Co., Chicago, has been moved to the company's Pershing Road plant at 300 W. Pershing Road, in order to combine all purchasing for the two plants under the supervision of HENRY M. COEN, purchasing agent.

Plymouth Industries, Inc., Plymouth, Ind., has been formed to manufacture hardening cabinets and stokers. Incorporators are A. A. GIZBE, J. A. DROMAN and J. HARRY WRIGHT.

• OBITUARIES •

Frank Richards

Frank Richards, who was well known by the older readers of *American Machinist* as a former associate editor, died on May 21 at the age of 94. Mr. Richards was of English birth, coming to this country when ten years of age, and living in the vicinity of Troy, N. Y., until he came to New York about forty years ago. He was for many years associated with Starbuck Brothers in building steam engines and Tolhurst Brothers on centrifugal drying and similar machinery, and later with the Ingersoll-Rand Company. Frank Richards was a contributor to the *American Machinist* long before he became a member of the editorial staff, and under the pen name of Tecumseh Swift he wrote of things both serious and fanciful, but always with a reflection of his kindly nature. His was a wide experience as evidenced by his articles on isometric projection, steam engines, general machine work, management and in his painstaking answers to the many questions that come to a paper of this kind. Outliving most of his direct associates, his name recalls many pleasant memories to those who were privileged to know him intimately.

DEAN G. KIMBALL, 66, president of the Walcott Machine Co., and head of the Crankshaft Machinery Co., Jackson, Mich., died May 21. Mr. Kimball came to Jackson from Elkhart, Ind., in 1915 and joined the Walcott & Wood Machine Co., which later became the Walcott Machine Co.

LOUIS A. HOERR, president of the Western Railway Equipment Co., St. Louis, and the Railway Devices Co., died May 26 at the age of 57.

JOHN A. UBSDELL, president and general manager of the Great Lakes Engineering Works, and connected with the concern since 1902, died at the age of 66 after a long illness.

E. E. GUNTERT, representative for the Goddard & Goddard Co., Inc., Detroit, Mich., in the greater part of New York State, died May 16 at Rochester.

EDWARD P. FRICK, 67, founder of the Frick Bros. Machine Shop, Syracuse, N. Y., and head of the firm for 30 years, died May 20.

• MEETINGS •

AMERICAN FOUNDRYMEN'S ASSOCIATION. Annual convention and foundry and industrial exposition. June 20-23. Stevens Hotel, Chicago. C. E. HOYT, executive secretary, 222 West Adams St., Chicago, Ill.

NATIONAL METAL TRADES ASSOCIATION. Thirty-fifth annual convention, June 8. Annual meeting of administrative council, June 7. Congress Hotel, Chicago. J. E. HYNAN, national secretary, Peoples Gas Bldg., Chicago.

SILVER BAY INDUSTRIAL CONFERENCE. Sixteenth annual conference on industrial relations. August 23-26. Silver Bay on Lake George, N. Y. E. C. WORMAN, secretary, 347 Madison Ave., New York, N. Y.

SOCIETY OF AUTOMOTIVE ENGINEERS. International automotive engineering congress. August 28-September 4. Palmer House, Chicago. JOHN A. C. WARNER, general manager and secretary, 29 West 39th St., New York, N. Y.

Meetings During Engineering Week Chicago World's Fair

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Semi-annual meeting. June 25-30. Palmer House, Chicago. CALVIN W. RICE, secretary, 29 West 39th St., New York, N. Y.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. June 26-30. Stevens Hotel, Chicago. C. L. WARWICK, secretary, 1315 Spruce St., Philadelphia, Pa.

MIDWEST ENGINEERING & POWER EXPOSITION. June 25-30. Coliseum, Chicago. Headquarters, 308 West Washington St., Chicago, Ill.

SOCIETY OF INDUSTRIAL ENGINEERS. Annual meeting. June 27-30. Stevens Hotel, Chicago. GEORGE C. DENT, secretary, 205 West Wacker Drive, Chicago.

THE ROUND TABLE

Keeping Time

"Say, Al, do you need a clerk or timekeeper down at your shop? Charlie Grace was out to my place the other evening. He needs a job mighty bad."

"I'm sorry, Ed. I always liked Charlie, but we don't intend to use clerks. We have one girl who is bookkeeper, purchasing agent and cashier combined, and that's all we expect to have."

"How do you keep track of the men's time—time clocks?"

"No, we pay every man so much a week and don't need either clock or timekeeper."

"How about when a man is late or absent?"

"We pay him just the same. He gets just so much in his pay envelope every Saturday, whether he has been in all week or not at all."

"That's certainly a slipshod way of running a shop. You must lose a lot of money that way."

"No, we don't; we save a timekeeper at about $18 a week, and our absences do not average $5. It costs more to keep time than it saves."

"But how can you keep track of your costs if you don't keep track of the men's time?"

"We don't keep costs. That is, not like you're used to. Making up costs requires much more judgment than a cost clerk is capable of exercising. I make up all costs myself, and I can bank on them."

"Yeah, but you can't continue to do that. It takes too much time."

"Not if you make them up like we do. We make them once for all."

"That would be fine if materials and labor would only stay put, but unfortunately, costs have to be accurate."

"Right you are, Edward, and ours are accurate because we have no clerk making fresh entries. I know just how long it actually takes to build a compressor, and I know how long it should take. We don't put all our delays and errors into our costs."

"But how about material prices? They don't stand still, either."

"We take care of that by dividing our costs into constants and variables. Outside of cast iron, the materials used in our compressor are in such small quantities that a variation of even 25 per cent would not appreciably change the costs. So we make them constants. We pay our men by the week and that makes our labor rate a constant. We add all the constants together and only have a single variable; the cost of cast iron. We fix a base price for cast iron and multiply a factor by the increase or decrease from that base. This gives us up-to-the-minute costs at any time."

"I don't get what you mean by a 'constant.' I don't believe our cost department ever used them."

"Probably not. Sometimes, if you are interested, I would like to talk costs with you, Ed. About 90 per cent of the items on which costs are kept are unnecessary."

"Thanks, Al, but the only time I'm interested in costs is when some clerk bothers me for estimates, and then my interest is how to get out of giving them. But I can see where they are necessary."

"Necessary, yes, but not the way most people do it."

"But I can't see how your costs will be any more accurate than ours if we put a man on them that knows enough to throw out freak machining or assembly times and prices. Even you can't tell how many bad castings there may be in a lot, nor how much time will be spent in finding out they are bad. Parts do not always go together alike, either."

"All admitted, Ed. I'm not fooling myself that my costs are accurate, but they are as accurate as the best, and they don't add still more to the cost."

"Well, you can get away with most anything in a small firm."

Can Al get by without a cost and time clerk? Will a standard cost system apply to the small shop?

Discussion

A Better Shop

Yes, Al, there are quite a number of things you can do to make a man's job more attractive apart from adding to the contents of the pay envelope.

Some of the items I am going to suggest may be old in theory though seldom practiced, especially in recent "adjustment" days. One of these is our old friend, adequate washroom facilities. Nothing is so refreshing, at the end of a warm and dusty day's toil, as the sight of a clean, inviting washroom, replete with plenty of hot water, clean towels and soap—not to forget ample locker space where a man's street clothes and personal belongings can be safely stowed. If you like also, you can allow the men the last ten minutes before official quitting time for performing their ablutions.

Then there is the idea of overall supply. One concern, I was identified with, had an arrangement with a local overall supply house whereby each man had a clean overall to step into every Monday morning. It cost the men nothing—and it certainly was appreciated.

These simple items add a little more to overhead, yet to the man at the bench and lathe, they mean something more—an appreciation of the management's regard for their comfort in working conditions. The average workman does not want to be patronized, nor does he expect Utopian conditions as regards wages or working hours, but he does like to know that his efforts are appreciated. —Robert S. Alexander.

Production Control

When Al spoke to Ed about a production control system, Ed probably had visions of a staff of men working on charts, making routing schedules and issuing job order tickets, but Al, no doubt, had something much simpler in mind. Al certainly does not need an elaborate system, but it is just as certain that he needs a simple system which he can undoubtedly devise. If there is not a definite plan, there is sure to be a lot of lost motion, and considerable money will get tied up in materials. Al should sit down with the blue prints of his compressor, make estimates of the time required for each operation, compare these times with the available machine and man-hour capacity of his shop, and from this data, prepare a definite schedule of operations.

The plan should aim to have all the parts ready to assemble a compressor at regular intervals with a minimum amount of materials and finished parts on hand. By doing this, Al will conserve his capital; get better delivery.

—C. J. Morrison.

If by production control in a small shop it is meant that a man, or a department, will give all his time to planning and scheduling, it is absurd. But if what is meant is that the foreman or superintendent sits down at night and plans out what is to be done the next day and keeps a record of it, then it is absurd not to do it.

We used to think that this was best done on the back of an old envelope, but blocks of paper bought at the local "five-and-ten" are neater and more likely to be kept for reference. In fact it is not a bad idea to keep these memoranda and mark on them the changes made as the day wears on.

One of the commonest danger points in any growing organization comes when it is decided to hire a bright young college graduate to run the planning and scheduling of production. Then come printed forms, the close adherence to plan, no matter if a better way thrusts itself in front of the planner's eyes. At this point, there should be placed a sign, painted in large letters, "Beware of the tail that wags the dog." —E. H. Fish.

Follow the Leader

Financial circumstances generally force the smaller manufacturer to employ more skilled and careful workmen than the larger manufacturer, and because of closer personal contacts between the managements and men, a higher standard of personnel is generally maintained in the smaller shops.

When the smaller shop is forced to retrench and dispense with the services of their mechanics, these ex-employees experience difficulty in placing themselves to advantage and in competing with less capable ex-employees of larger plants in the selling of their services. The average personnel or employment manager of a large corporation too often

lays greater stress on the financial rating of a previous employer than he does on the grade and type of work a previous employer produces.

A man who is working for a small shop is not building up as helpful a background as the employee of a large well rated company. This fact should be taken into consideration in adjusting his compensation.

The hourly rate of Al and Mason's employees should be in line with the prevailing wages paid by other employers in the same locality, and an incentive system should be installed whereby everyone will participate in above average company earnings. A treasurer or other administrative officer can see the merits of an annual bonus or stock ownership plan, but the average machinist or toolmaker's incentive to be effective must be in his weekly pay envelope.

—Ira S. Williams.

Renovizing

Al's idea is the right one.

Preparedness is the essence of all things. He is preparing his building so that, when he takes possession, he has the advantages of all of the good points. He has arranged for adequate light, for a floor that is easily cleaned. He states that the costs will be about $500, but he makes no mention of the savings, some of which would be rather difficult to evaluate beforehand. He will save the extra money that it would cost to paint and clean after the machines were already in operation. This would be a saving in money lost because of interruption of work, through inattention, moving out of the way, and the time necessary in cleaning up after the painting was finished.

The fact that Al is looking out for the essential things that affect his workmen shows that he is a leader. The old machines and tools can be replaced, one at a time, when needed. Possibly, as he gets into the production swing, he will see new advantages in choosing different types of tools and equipment which he does not see and understand at the present time. —H. M. Crooks.

Is Talk Cheap?

Talk is no cheaper than the time to say it, and that can run into real money. All salesmen, however, should not be shunted out of the office because "time is money." There are really four policies dependent on the following:

1. Is the prospect in the market at present for the product?
2. Will the prospect be in the market in the near future?
3. Can the salesman supply useful information, as most good salesmen can nowadays, even though no sale is contemplated?
4. Is there no possibility of a sale?

If the answer to the first is yes, then there is little doubt that the salesman will be listened to.

There is more doubt as to the salesman's reception in the second case. Unless he has concrete facts and figures, which can be filed until a decision is required, he might as well not talk, or be heard. The "hot air" or "high-pressure" salesman must get a signature on the dotted line while the prospect is "hot." If he doesn't, the buyer will come out of his hypnotic state. Often direct mail or magazine advertising will help more in this case than salesmen's calls. Case 3 is similar to Case 2, because information of real value should be given an audience, even though not immediately needed.

All salesmen suffer because of the poor judgment of those who insist on bothering people who are not prospects, as in Case 4. Buyers build up a "defense mechanism" as the psychologists put it, that reacts unfavorably on all salesmen. —Bernard Shereff,

Engineer, Standard Department, American Hard Rubber Company.

American Machinist
REFERENCE BOOK SHEET

Involute Spur Gear Block Gaging—II

A METHOD for the block gaging of gear teeth, contributed by Earnest Wildhaber (*AM*—Vol. 59, page 551), includes a table for determining the number of tooth spaces over which the measurement W should be taken in reference to the number of teeth in the gear so that the calipers will contact in the vicinity of the pitch line or well within the outside diameter of the teeth. See Figs. 1 and 2. For the number of teeth listed, this table avoids the necessity of computing the maximum block width. Mr. Wildhaber arranged his formula so that the measurement of gears of various tooth thicknesses could be determined.

A reference book sheet by Francis W. Shaw (*AM*—Vol. 76, page 632) deals with the more simple problem of standard tooth thickness and presents several tables tending toward further simplification. His formula for 1 D.P. gears, however, is still somewhat involved:

$$W = [\tfrac{1}{2}\pi\,(2N-1) + t\,(\tan\phi - \text{arc}\,\phi)]\cos\phi$$

Where:

W = Measurement across the profiles,
ϕ = Pressure angle,
t = Number of teeth in the block,
N = Number of teeth in the gear.

Once this measurement is known for any given number of teeth t, W for any standard diametral pitch will be W/D.P. This fact applied to Mr. Wildhaber's table makes possible the arrangement of the table appearing on the following page, which reduces the computation for the value of W to simple addition and division.

When the measurement is obtained from the table for the first number of teeth in the series (12 to 25), (25 to 37), etc., that for the following numbers of teeth is easily found by adding the increment per tooth. This is constant for a given pressure angle. When the diametral pitch is unity, the increase in pitch diameter ($2R$, Fig. 1) is exactly 1 in. per tooth. As the base diameter $2r$ equals the pitch multiplied by the cosine of the pressure angle, the increase in base diameter is always equal to the cosine of the pressure angle. As the difference between the tangent of the pressure angle and the pressure angle expressed in radians (inv ϕ) is constant for any pressure angle, it follows that the length of the base tangent W is increased by the cosine of the pressure angle multiplied by inv ϕ. For example:

$$\cos 14\tfrac{1}{2} = 0.96815$$
$$\text{inv}\ 14\tfrac{1}{2} = 0.00555$$
$$0.96815 \times 0.00555 = 0.00537 = \text{increment per tooth.}$$

Inv ϕ is found by reference to Professor Earle Buckingham's book "Spur Gears" which also contains a description of Mr. Wildhaber's method.

The table on the following page has been drawn up to make this method of measurement available for shop use without the necessity for technical computation. The formula used in computing the measurements is included to make the sheet suitable for engineering reference.

For the measurement of numbers of teeth, other than the first of each series, add the increment per tooth to the figure given. This gives the measurement for 1 D.P. Then divide by the diametral pitch.

For stub tooth gears of 6/8, 10/12 pitch, etc., the value of W is the same as for full depth gear, if it is remembered that the numerator designates the actual pitch. Thus in the first example given, had the pitch been designated as 10/12 instead of 10 D.P., W would have been the same.

The measurement for some teeth can be taken with regular micrometers, but in general, the method contemplates the use of standard vernier calipers (not gear tooth calipers). However when regular inside micrometers are available and when the jaws are calibrated to permit gaging as shown in Fig. 3, measurement is facilitated as verniers cannot be read with the rapidity of micrometers.

Contributed by Sam Trimbath

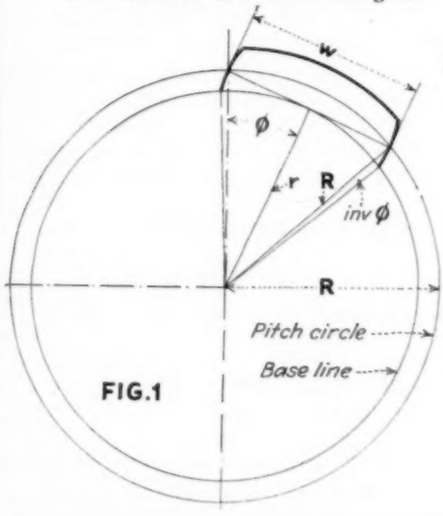

FIG.1

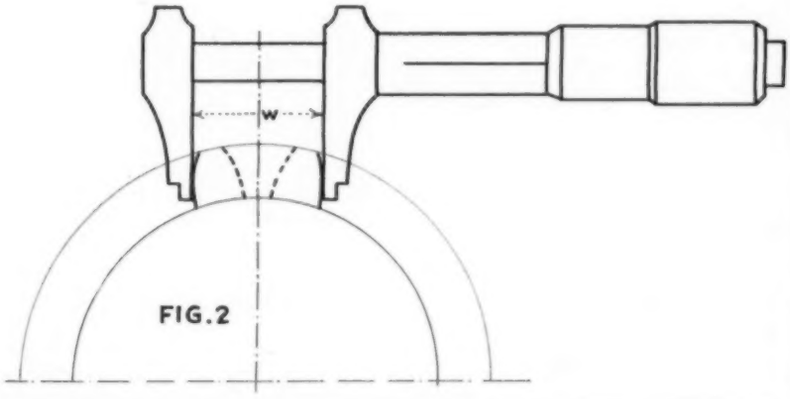

FIG.2

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REFERENCE BOOK SHEET

Involute Spur Gear Block Gaging—II

TABLE FOR DETERMINING INVOLUTE SPUR GEAR BLOCK GAGING MEASUREMENTS AND NUMBER OF TEETH IN THE BLOCK

Pressure Angle			$14\frac{1}{2}°$			17°			20°			$22\frac{1}{2}°$			25°		
Increment per tooth (I)			0.00537			0.00864			0.01400			0.01987			0.02717		
	t	N	w	t	N	w	t	N	w	t	N	w	t	N	w
	2	12 25	4.6268	2	12 21	4.6101	2	12 18	4.5962	2	12 16	4.5922	2	12 14	4.5970
	3	26 37	7.7435	3	22 32	7.7008	3	19 27	7.6464	3	17 24	7.5940	3	15 21	7.5257
	4	38 50	10.8497	4	33 42	10.8001	4	28 36	10.7245	4	25 32	10.6555	4	22 29	10.5632
	5	51 62	13.9610	5	43 53	13.8907	5	37 45	13.8026	5	33 40	13.7169	5	30 36	13.6279
	6	63 75	17.0669	6	54 64	16.9901	6	46 54	16.8808	6	41 48	16.7783	6	37 43	16.6653
	7	76 87	20.1784	7	65 74	20.0894	7	55 63	19.9589	7	49 56	19.8399	7	44 51	19.7027
	8	88 100	23.2844	8	75 85	23.1800	8	64 72	23.0370	8	57 64	22.9013	8	52 58	22.7674
				9	86 96	26.2791	9	73 81	26.1154	9	65 72	25.9627	9	59 65	25.8049

t = *Number of teeth in the block*
I = *Increment per tooth*
N = *Number of teeth in the gear*
w = *Caliper setting for 1 D.P. gears*
w' = *Caliper setting for finer than 1 D.P. gears*

For pitches finer than 1 D.P.

$w' = \frac{w}{D.P}$

Example No. 1 - 12 teeth - 20° P.A. - 10 D.P.

$w' = \frac{4.5962}{10} = 0.4596$ t=2

Example No. 2 - 21 teeth - 20° P.A. - 10 D.P.

7.6464 = w for 19 teeth

I = 0.014

7.6464 + 2I = 7.6744 - w for 21 teeth

$\frac{7.6744}{10} = 0.7674 = w'$ t=3

Example No. 3 - 18 teeth - 20° P.A. - 10 D.P.

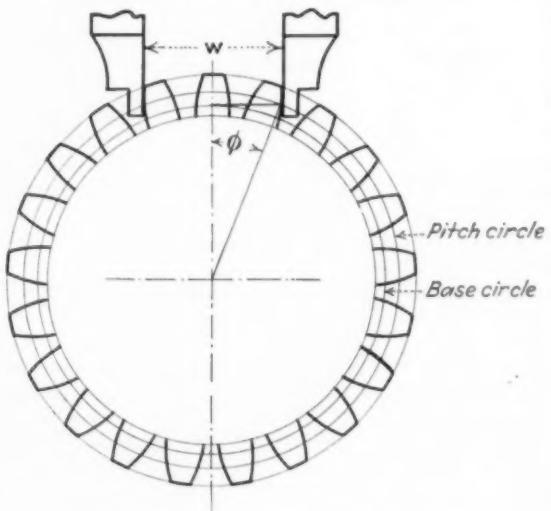
4.5962 = w for 12 teeth

I = 0.014

4.5962 + 6I = 4.6802 = w for 18 teeth

$\frac{4.6802}{10} = 0.4680 = w'$ t=2

Formula Used in Computing Table



w = *Measurement across profiles*
ϕ = *Pressure angle*
r = *Base radius*
t = *Number of teeth in the block*
N = *Number of teeth in the gear*
inv ϕ = Tan ϕ - ϕ in radians

$w = r\left(\frac{\pi(2t-1)}{N} + 2\,inv\,\phi\right)$

$\frac{3.1416}{circular\ pitch} = Diametral\ pitch$

Example No. 4 - 12 teeth - 20° P.A. - ¼" C.P.

$\frac{3.1416}{0.250} = 12.567 = D.P.$

$\frac{w}{D.P} = \frac{4.5962}{12.567} = 0.3657 = w'$ t=2

Increment per tooth = cos ϕ inv ϕ

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Keeping Two Presses in Step

WALTER WELLS

In making ferrules of a type used in the handles of can openers, the first, or drawing operation, tended to get far ahead of the second operation of piercing the closed ends for the tangs.

The drawing operation was set up with full automatic feed, while the second operation was performed in a press equipped with a dial feed, the loading being done by hand. This press ran more or less continuously at its maximum of 50 strokes per min. Two of the ferrules are shown at the top, the one at the left as it came from the drawing operation and the one at the right after the piercing operation.

Since the ferrules were produced by the million, this constant lagging behind, with it interruption to "follow through," proved to be uneconomical. Speeding up the press did not help, as the momentum of the dial not only caused frequent misses in positive indexing, but also by its very speed defeated its given purpose, since individual stations did not remain long enough in one position to be loaded successfully. And using two second presses was not considered so long as there were other ways to overcome the difficulty.

After some experimentation to be assured that an experienced operator could load more pieces if the dial rotation were slowed up, a thorough reorganization of the operation was made. A double die was made, and the dial plate was refitted with double-holed bushings. The press was slowed down to 40 strokes per min., and a sheet-metal fender was rigged up to help guide the loading. As a final means of eliminating all "dead spots," the operator on the companion job (automatic drawing) alternated with the operator of the piercing press, thus assuring continuous feeding, and at the same time reducing the fatigue factor for both men. Other features in this set-up were the provision of a duplicate die, to obviate more than a moment's interruption when regrinding or adjusting, and the design of the pick-up.

A standard ratchet-dial feed to fit the press was used. The die-set was also of standard design and was set into the dial bolster in such a way that the bolster could be preserved as much as possible for other set-ups. The punch-holder remained as it was, but the die-pad was sawed off short, as shown, and was doweled to a die-plate. One side of the pad had to be relieved to prevent interference with one of the locking pawls. The die was inset into the die-plate.

Faster loading when the speed was reduced was possible because full advantage could be taken of the "rest" position of the dial, the duration of which was but one-half the time of the complete cycle of the stroke. Helped to a certain extent by the convenient shape of the ferrules and by using both hands, the operator was able to load comfortably and continuously.

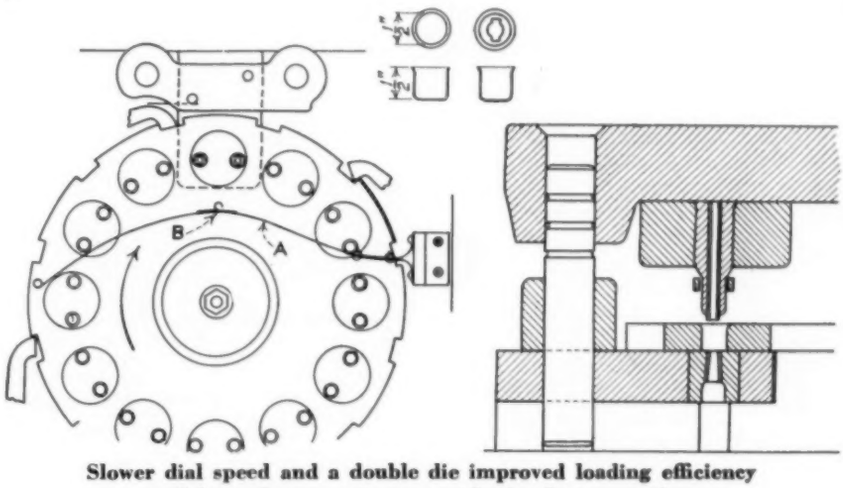
Two other aids are the 5-in. sheet-metal strip *A*, at left, which gathers and guides the massed ferrules directly to the loading area, and the ample clearance of 0.020 in. in the bushing holes. Incidentally, the guide also acts as a safety guard, because of the hinge at *B*. A light spring holds the guard in its normal position. Since the ferrules have flanges, they can enter the holes, or nests, right side up only. Therefore, when they are shoveled to the left side of the dial bearing, they travel clockwise around the latter, ready to be pushed directly into the nests, or else to be dropped in by a flipping, inverting motion of the index finger. Without the flanges this could not be done because of the chance of the ferrules dropping in wrong side up.

A sectional view of the tools seen at right. The punches are firmly supported by a ¾-in. sleeve, which is fitted to the punch-plate and is turned down and tapered so as to function as a locating pilot for the ferrules. The punches extend but a scant ⅛ in. below the pilot and are secured to the sleeve by a setscrew (not shown). The pilot has a shallow air vent, as it is a close fit in the ferrules. The pick-up is in reality the familiar knockout stripper, the ferrule sticking to the punch until the ram reaches the upper part of the stroke. The knockout, which is in the form of a nut screwed on the end of a pin extended up to the crossbar knockout of the press, stradles both punches. At the moment of stripping, an air blast blows the ferrules into a wide-mouthed chute.

The holes in the bushings were laid out and then carefully drilled and reamed while in position on the bolster. The job was done on a vertical miller, the indexing being done by using the ratchet lock on the dial. The chord between two holes (1.501 in.) was spaced by the micrometer collar on the feed screw of the machine table.

While this job did not have to be fussy, the location of the die in its place and the positioning of the guide pins had to be precise. The bolster and the two die-sets were bored while clamped in position, after which the die-plates were centralized and doweled. The guide pins not only slide into the punch-holder but extend down into the bolster for a similar fit. A broach was made to insure uniformity in the four dies for the two sets, and was also used to cut out the holes in the punch sleeves. The punch stock was made in quantity to last a long time.

To make up for the stock cut away in regrinding, packing had to be inserted behind both the punches and the die. Plain drill rod was used for the punches and bushing stock for the die. This was a slight drawback, as the thickness of the packing had to be added to each time the tools were ground.

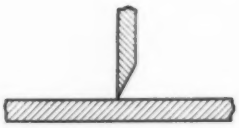


Slower dial speed and a double die improved loading efficiency and kept the press in step with the first operation

Press Work Pressures

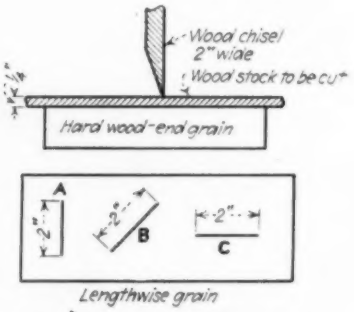
Series VII—*Cutting*

(Non-Metallic Materials)



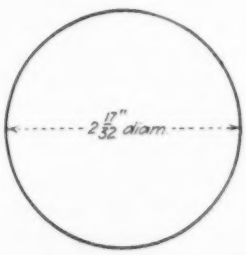
Material--Hard and stiff rubber with five layers of cotton fabric
A. 0.325 in. thick
B. 0.089 in. thick rubber with some fabric in it
Operation--A. Cut through with ordinary wood chisel
B. Cut a blank 2-9/16 in. in diameter with hollow cutter
Pressure--A. 200 lb. B. 600 lb.

Material--Medium hard leather, 0.14 in. thick
Operation--A. Cut with wood chisel 1 in. wide
B. Cut with wood chisel 1-3/4 in. wide
Pressure--A. 200 lb. B. 350 lb.

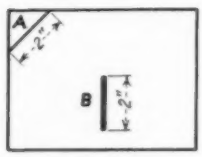


Material--White pine, mahogany and walnut
Operation--Cut a slit at A, B, and C with a wood chisel 2 in. wide
Pressure--

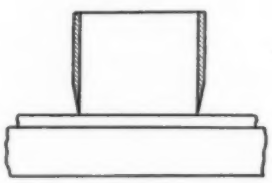
	A	B	C
White pine	400	300	200
Mahogany	1000	500	600
Walnut	1100	600	400



Material--A. Linoleum, 0.056 in. thick
B. Roofing material, 0.057 in. thick
Operation--Cut with hollow cutter die
Pressure--A. Six blanks at once, 800 lb.
B. Six blanks at once, 800 lb.



Material--Pulp or fiber board, 0.175 in. and 1/4 in. thick
Operation--Wood cutting chisel
A. Cut off corner
B. Make a slit
Pressure--A. 0.175 in., one piece - 900 lb.
0.350 in., two pieces - 1,000 lb.
1/4 in., one piece - 1,000 lb.
B. 0.350 in., two pieces - 1,600 lb.
1/4 in., one piece - 1,100 lb.

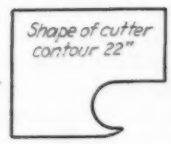


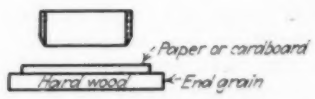
Material--Pasteboard,
A. 0.113 in. thick
B. 0.064 in. thick
Operation--Cut with a hollow cutter die. Circumference 8 lineal in.
Pressure--A. 700 lb.
B. 1,100 lb. to cut six

Material--Pad paper, 0.003 in. thick, 83 sheets 1/4 in. high
Operation--Cut with three hollow cutter dies at one time, to cut blanks 8 in. in circumference
Pressure--2 tons

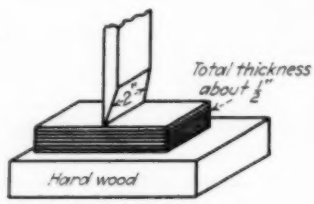
Material--Newspaper, total thickness, 1 in.
Operation--Cut with hollow cutter die 22 in. in circumference, cutting near the edge
Pressure--1/4 in. through - 1,700 lb.
1/2 in. through - 3,600 lb.
3/4 in. through - 4,200 lb.
1 in. through - 5,000 lb.

Material--Cardboard, 11 pieces, total thickness, 17/32 in.
Operation--Cut with hollow cutter die, 22 in. in circumference
Pressure--1/4 through - 4,800 lb.
1/2 through - 7,000 lb.
3/4 through - 9,000 lb.

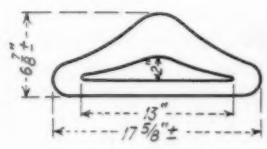




Material--Paper or cardboard, large sheets, 1 in. high
Operation--Cut with hollow cutter die, cutting in center of sheets
Pressure--1/4 in. through - 1,900 lb.
1/2 in. through - 3,800 lb.
3/4 in. through - 4,500 lb.
1 in. through - 5,000 lb.



Material--Muslin, 0.015 in. thick, 35 thicknesses totaling about 1/2 in.
Operation--Cut with chisel-edged die, 2 in. wide
Pressure--20 lb. per in.



Material--Pasteboard, medium hard, 0.145 in. thick
Operation--Center piece cut with hollow cutter dies. Outside contour, 41 in., inside contour, 27 in.
Pressure--8,000 lb.

Material--Belt leather
Operation--Score 4 in. long, 1/32 in. wide 1/64 in. deep
Pressure--400 lb. or 100 lb. per inch

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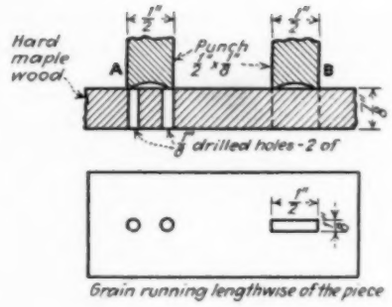
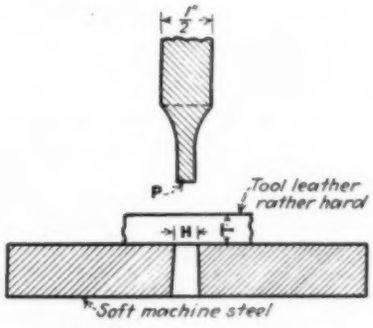
Press Work Pressures

Series VIII —*Punching*

(Non-Metallic Materials)



Material--Hard maple wood, 7/8 in. thick
Operation--Punch a slot 1/2 in. long by 1/8 in. wide
A. After drilling the two holes
B. Without drilling the two holes
Pressure--A. 550 lb. B. 1,000 lb.

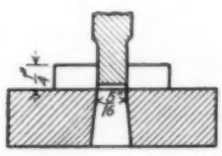


Material--Hard leather. T - thickness
Operation--Punch one round hole

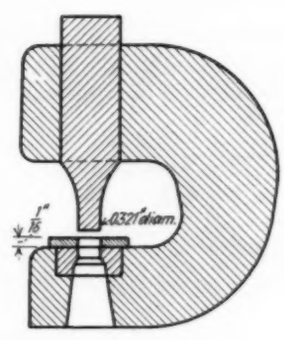
	P	H	T
A.	0.321	0.321	0.177 in.
B.	5/32	3/16	0.191 in.
C.	0.163	0.194	0.195 in.
D.	0.163	0.194	0.305 in.

Pressure--	A.	B.	C.	D.
	1,300	500	650	750 lb.

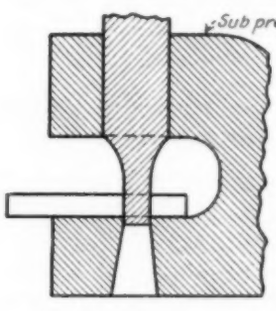
Material--Pad paper, 0.003 in. thick
Operation--Punch one hole -
A. 0.321 in. in diameter
B. 0.642 in. in diameter
Pressure--A. 900 lb. for 60 sheets
B. 4,800 lb. through 1/2 in.



Material--Hard fiber board, A. 0.064 in. thick
B. 1/4 in. thick
Operation--Punch a 5/16 in. hole
Pressure--A. 625 lb. or 5 tons per sq. in.
B. 2,500 lb. or 25 tons per sq. in. Greatest pressure when punch is half through



Material--Celluloid, 1/16 in. thick
Operation--Punch one hole 0.321 in. in diameter
Pressure--300 lb.



Material--Medium-hard cardboard, 3/16 in. thick
Operation--Punch one hole, 0.321 in. in diameter
Pressure--600 lb.

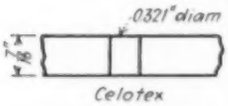
Material--Ordinary paste board -
A. 0.018 in. thick
B. 0.113 in. thick
Operation--Punch one hole 0.321 in. in diameter
Pressure--A. 200 lb. for three thicknesses
B. 400 lb. for one thickness

Material--Cardboard - A. 0.060 in. thick
B. 0.064 in. thick
Operation--Punch a hole 1 in. in circumference
Pressure--A. 200 lb. for one thickness
B. 1,000 lb. for six thicknesses

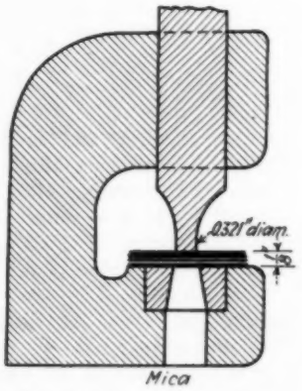
Material--Straw board, 0.430 in. thick
Operation--Punch one round hole 0.642 in. in diameter
Pressure--2,800 lb.

Material--Fiber board, A. 0.040 in. thick
B. 0.085 in. thick
Operation--Punch a hole through 1, 2, 3 and 4 pieces at a time (0.321 in.)

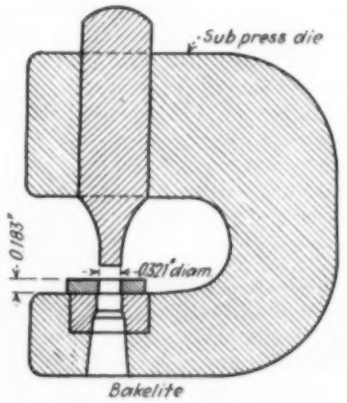
Pressure--	Number of pieces			
	1	2	3	4
A.	250	600	1,000	1,400 lb.
B.	350	650	950	1,200 lb.



Material--Celotex, 7/16 in. thick
Operation--Punch one round hole, 0.321 in. in diameter
Pressure--700 lb.



Material--Mica, A. 1/16 in. thick
B. 1/3 in. thick
Operation--Punch one hole 0.321 in. in diameter
Pressure--A. 1,200 lb. B. 2,700 lb.



Material--A. Bakelite, 0.133 in. thick
B. Semi-hard, black, vulcanized, sheet rubber, 1/4 in. thick
Operation--Punch one hole 0.321 in. in diameter
Pressure--A. 3,150 lb.
B. 900 lb.

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• IDEAS FROM PRACTICAL MEN

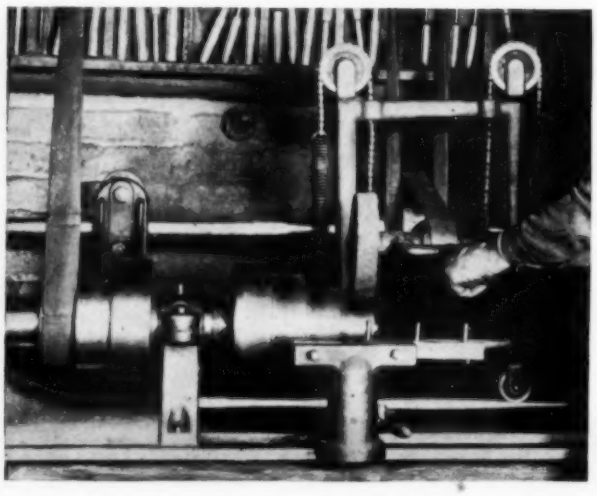
A Polishing Machine

A. E. GRANVILLE

A small manufacturing shop, using a limited quantity of cone and single pulleys in its product, improvised a polishing machine from an old lathe.

Two narrow belts from an overhead drum transmit motion to a sliding shaft running in bearings supported in brackets that are attached to the back of the lathe bed. The spindle of the polishing wheel is carried in bearings in a forked casting having bearings on the sliding shaft. A 3-in. belt running on pulleys on the sliding shaft and on the wheel spindle drives the polishing wheel. By this arrangement, the wheel can be moved up or down in an arc of which the sliding shaft is the center, and can be traversed almost the entire length of the lathe.

To counterbalance the polishing wheel and to keep it up out of the way when not in contact with the work, the outer end of the forked casting is connected to springs by means of chains running over grooved pulleys at the top of a bracket. To provide support for this bracket, two grooved rollers at its lower end bear on a rod running parallel to the lathe bed. Downward pressure on a handle in the polishing head brings the wheel into contact with the work, and at the same time keeps the rollers at the lower end of the counterbalancing bracket firmly in contact with the rod on which they bear. Thus, the movement of the polishing wheel is steadied and vibration is minimized.



This improvised polishing machine utilizes an old lathe and provides an adequate and efficient method for the small quantity of pulleys required. It is easily handled and out of the way when not needed

Important Features in the Design of Broaching Tools

F. SERVER

There are certain features to be kept in mind in designing fixtures for the broaching machine, both for holding the work and the broaches, especially if the broaches employed are of the pull type. To draw attention to these features, reference is made to the accompanying illustrations.

For splining the cluster gear, Fig. 1, it is held on a fixture at the end of the machine and in the fixture is a slot for guiding and backing up the broach. The work is located radially by the pin *A* in the fixture entering a hole drilled in the back of the cluster. In designing the work holder, the outer end should extend beyond the work a distance equal to about one and one-half times the pitch of the broach teeth, as at *B*, so that the broach will be properly backed up when it starts to cut.

In Fig. 2 are shown a head and a broach holder, in the latter of which the threaded shank of the broach is held by the threaded bushing *A*. The bushing is slit on one side and is clamped on the tang of the broach by a setscrew. The sliding plate *B* has a U-shaped opening and engages slots in the broach holder. It is placed ahead of the threaded bushing and is a very secure means of resisting the pull of the broach. In removing the broach from the holder, it is a simple matter to loosen the setscrew that clamps the bushing on the broach shank and to pull up the sliding plate. The broach and the bushing can then be withdrawn from the holder.

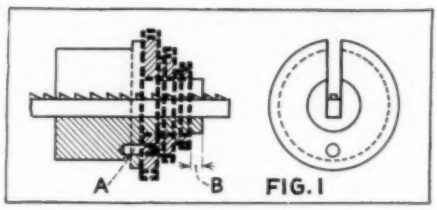


Fig. 1—The workholder should extend beyond the work to support the broach

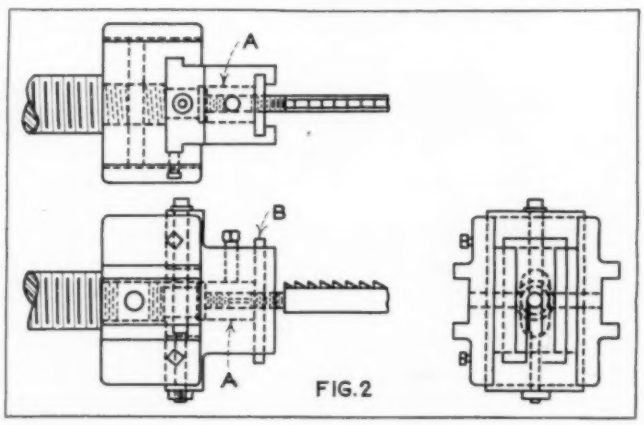


Fig. 2 — Broaching head and broach holder. Threaded shank of broach is held by a bushing, which is slit on one side and clamped to tang of the broach

The broaching head is screwed onto the operating screw and is further secured thereon by a taper pin through both members. The head is provided with a T-slot in which the holder engages. An adjusting screw and a locking screw provide for adjusting the holder vertically and for locking it after the adjustment has been made. Lugs

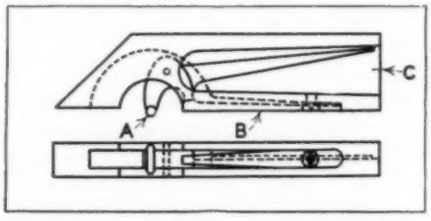
on each side of the head form channels for guiding it on the ways of the machine. In these tools features are provided for supporting and backing up the broach and for easy removal of the broach from the holder. Also, alignment and rigidity are well taken care of, all of which should be considered in designing broaching fixtures.

An Indicating Scriber for the Height Gage

STANLEY BALDWIN

Toolmakers who have occasion to use a height gage for either laying out or checking will appreciate the indicating attachment illustrated.

As will be readily seen, the attachment is intended to replace the scriber point furnished with the gage and to facilitate setting the scriber accurately on a block, pin or projecting point without depending upon the "feel" to determine when the point is exactly on the given surface.



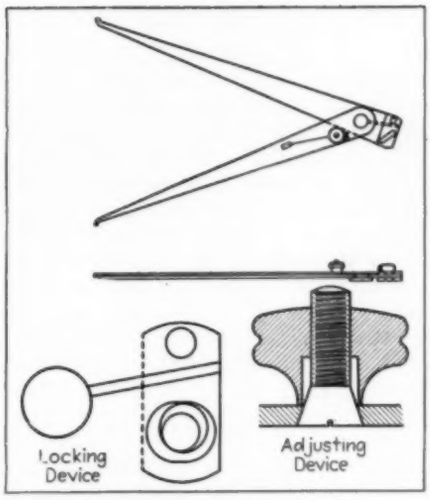
Indicating height gage that eliminates error due to "feel" of point

For ease in calculating, the scriber point is 0.01 in. above the surface that bears on the caliper jaw, and this amount must be deducted from or added to the reading on the slide, depending upon whether the point is above or below the work. For metric gages, this space should be either 1 mm. or $\frac{1}{4}$ mm. When the gaging point *A* is in line with the surface *B*, the needle point should coincide with the zero line *C* on the body. This attachment can be readily made in any toolroom, although it would be a more satisfactory arrangement if the manufacturers of height gages supplied something of the sort as regular equipment.

Old Calipers

PAUL JONES
Surrey, England

Herewith is a drawing of a pair of old inside calipers that may be of interest. The drawing is self explanatory, but I may add that the locking device is quite positive and the adjustment is very fine and regular. The devices for locking and adjustment are drawn separately to greatly enlarged scale.



Split-leg calipers of old vintage that could be adjusted to fine measurements

These calipers were apparently made a great many years ago somewhere in Massachusetts, but owing to age, use, etc., the maker's name is not decipherable. Perhaps some reader can supply it.

Simple Tools for Connecting Air Hose to Couplings

E. J. TANGERMAN

In a plant where I was in charge of air tools, several hundred lengths of air hose were in daily use and many joints had to be repaired each day. At first we used bolt clamps of the standard type, but we found they had a tendency to catch on any obstruction over which the hose was pulled. Finally we adopted clamps cut from a coil of soft-iron wire wound around a mandrel, as at *A*, Fig. 1. These clamps could be tightened by squeezing in a vise at several points of their circumference, forcing them into the hose so that they would not catch when the hose was pulled over obstructions. Light-iron wire twisted around the coupling and carried beneath the clamp, then twisted tightly about itself, prevented the hose and the coupling from parting company if the joint became loose.

While the method of tightening the clamps was entirely satisfactory, the quantity of joints that had to be repaired daily made it economical to provide a fixture to take the place of the vise. The air cylinder illustrated in Fig. 1 was made by clamping a short section of heavy brass pipe between two plates to serve as cylinder heads, the upper one being long enough to be bolted to a bench.

A block bored and threaded to fit the clamps, and then split, formed two halves of a die for compressing the clamps. One half of the die was attached to the piston rod and the other half to a plate held above the upper cylinder head by bolts from the lower one. With a clamp in place, the hose is placed in the lower half of the die and, by admitting air to the lower end of the cylinder, the two halves of the die are brought together, squeezing the clamp between them and holding the hose tightly on the coupling. With this device there is no danger of crushing the fiber of the hose or squeezing the coupling out of round.

Another simple tool for clamping the hose onto couplings is shown in Fig. 2. The clamps are heavy wire bent into U-shape, as at *A*, and are placed around the hose so that the free ends come through the loop, as at *B*. The safety wire is put on as in the case of the ring clamps. The tool is placed with its grooved end on the hose, the free ends of the clamp passing through holes in the body and into holes in the split clamping-block *C*, where they are

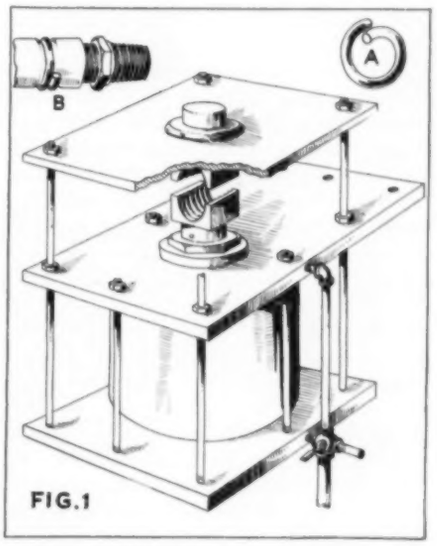


Fig. 1—This air-operated device saved time in wiring air-hose couplings

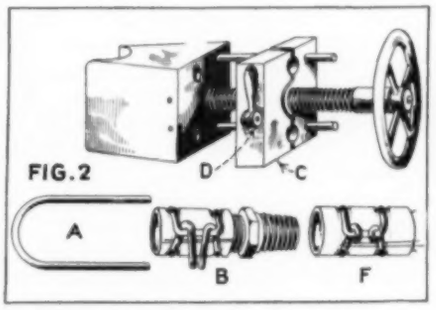


Fig. 2—Another handy tool for putting U-shaped binding wires on hose ends

clamped by the lever *D*. The screw is then turned by the handwheel, moving the clamping block away from the body and drawing the free ends of the clamp tightly through the loop, thus clamping the hose tightly on the coupling. The whole tool is swung about the hose as a pivot, bending the free ends of the clamp sharply over the loop. The free ends are then cut off, as at *F*, close to the loop.

Tool for Profiling Patterns of Wood or Soft Metal
Discussion

JOHN E. HYLER

The tool described by F. E. Fick in an article under the title given above (*AM*—Vol. 77, page 216) is certainly to be preferred over hammer and chisel, but as compared with other tools used for the same purpose, it has its limitations. The chief objection to the tool is that one must guide the stock by hand while following the lines by eye—a method that does not lend itself to much accuracy with a rotary tool.

Tools can be bought that have a rubbing band, or collar, of the same diameter as that of the largest cutting portion, to serve as a guide against a form. In using such tools, a piece of waste wood is bandsawed to the form to which it is desired to profile the pattern. The bandsawed form is temporarily nailed to the top of the pattern block, and the cutter is fed into the work far enough to permit the rubbing band to rub against the edge of the bandsawed form. Some care must, of course, be used in bandsawing the form, because any irregularities will inevitably be reproduced in the pattern. After one path has been cut, the cutter can be fed down deeper. If the rubbing band loses contact with the bandsawed form in the deeper cut, it will not make any difference, because the path just cut will act as a guide.

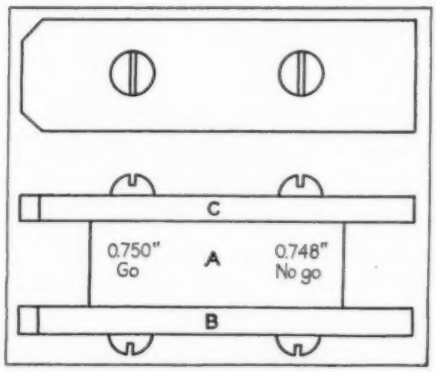
Without doubt, it would be possible to put a rubbing band on such a cutter as Mr. Fick describes, but it would be necessary to calculate how much the upturned teeth would add to the diameter of the body, and to turn the rubbing band to that diameter. As against the tools to be had in the market, the tool described by Mr. Fick, even if it were provided with a rubbing band, would be slow in operation.

Cutters with rubbing bands are available in fillet style at radii from ⅛ to 2 in., and in router style, for cutting square-bottomed slots, or recesses, from ½ to 2 in. in diameter. Corebox cutters of this type can also be had in sizes ranging from ¼ to 3 in. in diameter.

A Limit Gage

MARTIN H. BALL

The limit gage illustrated is recommended for its simplicity of design for both making and upkeep. The body block *A* is ground in thickness to the "No Go" size of the gage, but is not hardened as is is not subject to wear. The side members *B* and *C* are hardened and are ground straight on their working faces. Then an additional amount, equal to the limit required, is ground off of the face of one of the side members



Simple limit gage which can be readily corrected when gaging points wear

for a distance from the end to the depth of the jaw. The parts are assembled with four standard machine screws.

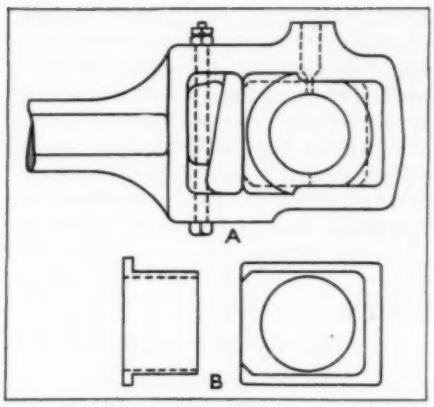
The "Go" end of the gage has the corners of its jaws chamfered to make that end more easily recognized. The gage may be made larger or smaller by removing the side members and attaching them to thicker or thinner body blocks. For a slight enlargement of size, filler pieces can be placed between one of the side members and the body.

Applying Floating Bushings to Markel-Type Main Rods

A. D. HOLCOMBE

We have a number of fifteen-year-old engines that were originally equipped with solid end main rods of the Markel type, as at *A*. Desiring to equip the crankpin ends of these rods with floating bushings, it was found that there was room enough to accommodate the bushings without making any change in the rods themselves.

A steel forging, as at *B*, to take the place of the brasses, was made for each rod. The forging had a flange on one side only. It was bored out as large as was possible and was machined for a tight fit in the rod. The rod end was heated and the forging was put in place with the flange toward the fillet on the



How floating bushings were used in Markel-type main rods

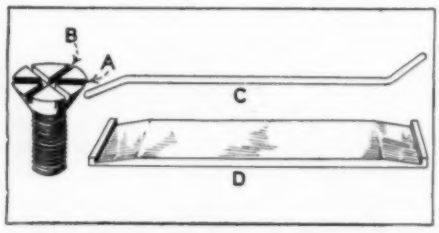
crankpin. When the rod end cooled, the forging was held tightly in place by the shrinkage. The bore of the forging was then ground on a planetary grinder and the floating bushing was fitted, the flange having a bearing against the eccentric crank. This alteration made a very neat job.

Putting in Machine Screws in Close Quarters

JAMES F. HOBART

In the reconstruction of a machine it was necessary in attaching some parts to insert several flathead machine screws through pockets cored in the casting. The pockets were closed on the top and were high enough to admit the screws, but by some unaccountable mistake they were not wide enough to permit the screws to be entered with the fingers, and no provision had been made for turning them. The clearance holes had been drilled through the web into the pockets from the bottom when the casting had been upside down. The holes were countersunk by a back countersink having a detachable cutter held to the shank by a taper pin. Some difficulty was found in assembling the countersink, the cutter having to be put in the pockets, but finally it was done.

So that the screws could be turned in the limited space, two extra slots were put in their heads, as at *A* and *B*. A piece of drill rod, *C*, that would freely



Special screwdrivers for putting machine screws in constricted places

enter the slots in the screw heads was bent slightly at one end, so that when pushed into the slots it was tight enough to hold the weight of the screws. A screw was lifted by the drill rod and dropped into one of the clearance holes. The opposite end of the drill rod was bent at an angle and this end was placed in one of the slots with the bent end pointed in the opposite direction and screw was turned until the drill rod struck the side of the pocket. The drill rod was then turned so that the bent end pointed in the opposite direction and the screw was turned until the drill rod again struck the side of the pocket. By continuing this process the screw was driven until the friction was too great for the drill rod to stand without bending.

Then we made the lever screwdriver *D*, the lips at the ends being at opposite angles. By turning the screw as far as possible with one end of this tool, the tool was changed end for end and the screw was turned further. By using this tool at alternate ends and in different slots, the screw was finally driven home.

Eliminating Scrap

JAMES MCINTOSH

Some years ago I was employed in a plant (an efficient one, too) engaged in the manufacture of piston rings, where the scrap was enormous. The trouble was in slitting the rings to produce the necessary spring. The slits were 3/8 in. wide, at an angle of 45 deg. and were made by a milling cutter 3/8 in. in width, the work being done in a hand miller. Due to the failure of the fixture to hold and properly support the rings against pressure of the cut, many rings were broken, causing no end of grief. In fact, the breaking of three rings out of five was not unusual.

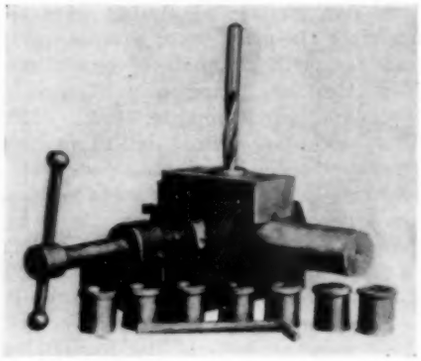
My solution of the difficulty was to replace the 3/8-in. cutter with two thin slitting saws, supported and spaced by suitable collars, and thus reduce the pressure of the cut. As a result of the change, using the same fixture, the output was increased and the scrap was eliminated.

Results can always be accomplished where there is ability to reason, and experience is the only teacher where keen supervision is absent. But modern methods have eliminated the demand for experience, and ability to reason is not wanted. Files and reamers have no place in an assembly line, and where there is organization the usual monkey-wrench mechanic and his methods have departed. Leaders are not made; they are born.

Jig for Drilling Crossholes

H. J. CHAMBERLAND

For drilling crossholes in round stock, the inexpensive jig illustrated will be found to be very convenient. This particular jig will accommodate stock from 1/4 to 1 1/2 in. in diameter, and the eight bushings will take drills from 1/8 to 1/2 in., varying by 16ths. Of course, the same kind of a jig can be made to accommodate stock of any diameter, and bushings can be made to take drills larger than those specified.



A V-block, a vise and proper bushings make it easy to drill crossholes

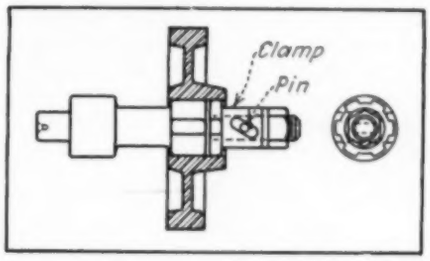
The jig body is a simple V-block and is held in the vise in close contact with the work to be drilled. A detachable plate fitted to one end of the body is provided with a screw and a lock-nut to form an adjustable stop, so that holes can be drilled in a number of pieces at the same distance from the ends.

A Mandrel for Splined Parts

A. L. HARTLEY

The mandrel illustrated is of very simple design. The splines on its body are a sliding fit in the splines in the work, while the splines in the clamp are slightly undersize and act as guides in loading. The helical slots in the hub of the clamp engage both ends of a pin that extends through the body of the mandrel. Hence, when the nut is tightened the clamp is rotated in a clockwise direction and securely locks the work. Since the machine in which the work is placed usually revolves in a counter-clockwise direction, the work is locked against the driving side of the mandrel splines. If the mandrel is to be used in a machine in which the spindle revolves in a clockwise direction, then the helical slots in the clamp should be cut so that it would be rotated in a counter-clockwise direction when the nut is tightened.

A mandrel of this type is very easily loaded, since the splines in the clamp act as guides when putting the work into position. After the work has been located, it is necessary only to give the nut two or three turns to lock it securely in place. The work is held securely and will not slip longitudinally along the mandrel under normal conditions. This method of holding the work gives assurance that the finished surfaces will run concentric with the splines, providing the mandrel runs true in the machine.



An easily operated mandrel for holding work with splined holes

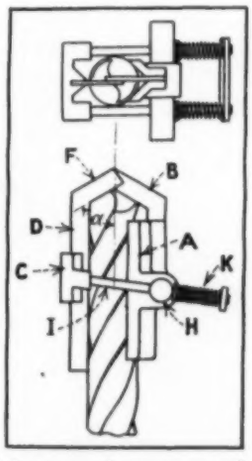
As shown in the illustration, the mandrel can be so designed that facing tools will have clearance to face all the way down the hub of the work without being ground to a sharp point.

A Gage for Drill Points

BERTIL FALCK
Mechanical Engineer,
Star Electric Motor Company

Not being able to buy a gage suitable for the accurate inspection of drill points, the one illustrated was designed and made in our toolroom.

As can be seen from the illustration, the gage consists of the V-block *A*, carrying the bevel gage *B;* the block *C*, carrying the straight-edge *D*, which terminates in the bevel gage *F;* the



Special gage for accurately inspecting drill points. This gage utilizes the showing of light and checks the angle very closely

mounting pin *H;* the two pins *I;* and the two springs *K*. The block *C* has two lugs which are drilled and reamed at an angle, and into which the two pins *I* are driven. These pins extend through clearance holes in the mounting pin and through the springs, and are connected by a bar at their outer ends. The mounting pin is fitted to slide on the pins *I* under pressure of the springs, carrying with it the V-block *A*. So that drills of various diameters can be accurately centered in the gage, the pins *I* stand at an angle, the tangent of which is equal to $\frac{\sqrt{2-1}}{\tan \alpha \sqrt{(2+1)}}$. Where the angle α is 59 deg., the angle at which the pins stand is 5 deg. 53 min. 9 seconds.

In use, the gage is held in the right hand with the bar at the ends of the springs resting in the palm. It is opened by grasping and pulling the mounting pin with the thumb and one finger, and the drill to be inspected is inserted with the left hand. Releasing the hold on the mounting pin, the springs close the gage upon the drill. Since light will show through an opening of less than 0.001 in., by holding the gage against the light, a comparison of the angles and lengths of both lips can be made at the same time, any difference being detected at once.

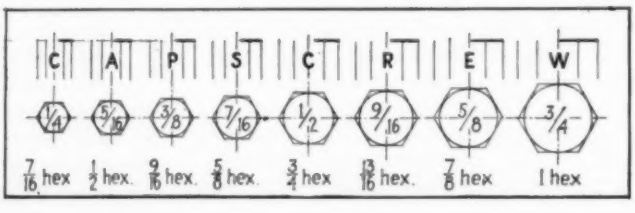
A Kink for the Draftsman

VICTOR H. KIDNEY
Chief Draftsman,
Fourness Development Corporation

As a subscriber to the *AM* I have noticed that it contains many helpful kinks for the draftsman, and I am adding this one to the collection.

The device illustrated is laid out on tracing cloth or on thin celluloid and is used in drawing hex head capscrews. The figures within the hexagons denote the body sizes of the screws, while those below give the distance across the flats of the hexagons. The short, heavy lines at the top, at right angles to the projections of the heads, give their heights. By turning the "templet" so that these lines are vertical, the height of any screw head can be quickly laid off.

This device does away with looking up head dimensions every time a capscrew is to be drawn in place, and it shows at once how much space, or clearance, is required for any capscrew head within its range.



This chart, on tracing cloth or celluloid, saves time in laying out screw heads and gives dimensions

SEEN AND HEARD

JOHN R. GODFREY

Cast Anchor Chain

Anyone who has followed Navy practice as to anchor chain will be interested in the new development at the Norfolk Navy Yard. Time was, and not so many years ago, when hand welds were the only thing permissible. One energetic commandant at Boston tried to introduce the machine, or squeeze weld, and met with all kinds of opposition. Now they are being cast of nickel-chromium, approximating SAE 3135 alloy steel, but with a bit of molybdenum added. These chains are cast, heat-treated and proof-tested, as too much depends on the anchor chains to take any chances. A 1-in. chain is tested to 60,000 lb. and a 3-in. chain to 495,000 lb., this being something over two-thirds of breaking load. Here the foundry takes work away from the forge shop instead of losing it to machine forgings or welded construction.

Collets or Split Chucks

It has been said that the watch industry hinges on the split chuck or collet. This invention is credited to Nashua, N. H., in the latter part of the first half of the eighteenth century. And though the collet consists of but a single piece of metal and looks like a simple proposition, we have it from one well known maker that it took four years to fill his first order with entire satisfaction to himself. Those who use collets regularly claim that a good set of wire collets and wheel or step chucks adds 50 per cent to the value of any engine lathe with less than a 20-in. swing. This, of course, refers especially to lathes used on a variety of work. And it is well to remember that he says *good* split chucks or collets, for there is more to the making of them than may appear on the surface.

Size, Carbon and Heat-Treating

Studying a problem from various angles often changes our ideas as to practice and methods. One concern used thousands of bolts from $\frac{7}{16}$ to $\frac{1}{2}$ in. in diameter. They used the same grade of steel for all sizes but found that the same heat treat gave different results. The small bolts were brittle and the large ones not hard enough. They decided that the small bolts were overheated and the large bolts not heated enough. As it was important from the standpoint of cost, to handle all sizes in one heat treat they changed the steel specifications slightly. Now the small bolts have not over 30 carbon, the medium size 32 and the large bolts 35 carbon. All receive the same heat treat and all are satisfactory.

Too Much Inspection

Inspection, like every other good thing, can be carried too far, sometimes at considerable cost. There are two railroad shops, hundreds of miles apart, that serve as contrasting examples. One tests every boiler tube before it goes into the boiler. The other does no testing until the tubes are all in the boiler. One uses an elaborate method of brazing safe ends with a long taper on both parts and a copper ferrule between. The other butt-welds the safe ends in a fraction of the time. The one that tests every tube had to go back three years to find a record of a leaky tube. The other has welded several thousand tubes without finding a leaky one. While it is cheaper to test a tube out of the boiler than to cut out a poor one after it is in place, it is a lot cheaper to do this once in three years than to handle every tube on the test rack. There are many similar cases where one hundred per cent preliminary inspection is a costly practice.

Give Details When Asking for Information

A great mistake of those asking for information on almost any subject is the failure to give complete details of what is wanted. The man who asks usually knows what he wants and forgets that the man he writes to is no mind reader. Two of the important points are the number of pieces involved and the accuracy that is actually necessary. It frequently helps a lot to know how the piece is to be used, though most inventors and designers have the notion that everyone is waiting to steal the idea. Where only a few pieces are needed it is frequently possible to use a less expensive material for tools than as if long runs were necessary. In one case, for example, a drop-forge concern uses high-carbon steel dies where the run does not exceed 1,000 pieces. For longer runs they use a special nickel-chromium-molybdenum steel, hardened and tempered to 285-341 Brinell. These will forge 7,000 crankshafts before resinking is necessary.

SHOP EQUIPMENT NEWS

Farrel-Birmingham 60-In. by 20-Ft. Heavy-Duty Roll Grinder

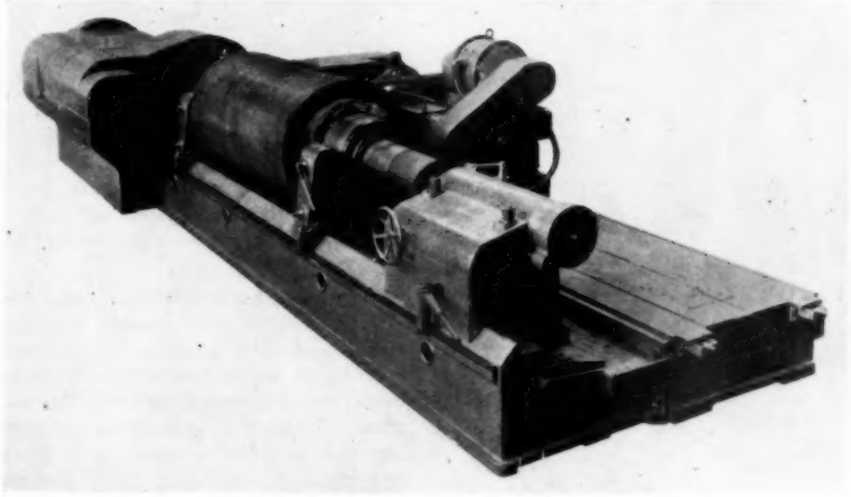
Roll grinders now being used in strip and sheet mills must be capable of taking care of the backing rolls of four-high mills, and also must be equally capable of taking heavy cuts for rough grinding and applying mirror surfaces on rolls for rolling high-finish sheets. The Farrel-Birmingham Co. Inc., Ansonia, Conn., has recently developed such a grinder of 60 in. by 20 ft. capacity. This machine has a number of features designed to eliminate vibration, to promote accuracy of crowning or concaving, as well as straight grinding, and to refinish rolls in a short time.

The outstanding improvement in design is in the method of driving the roll. The speed reduction from the motor to the roll is obtained through four multiple V-belt drives, three of which are used at one time. A jaw clutch between the two intermediate drives throws one drive out and the other in, making possible a variable speed range from 6½ to 67 r.p.m. on the roll with a standard 4 to 1 motor.

A backlash eliminating gear has been added to the patented crowning device, and assures synchronism between the wheel carriage and wheel when crowning or concaving a roll. The crowning device eccentric has been moved in closer to the way, giving firmer support to the wheelhead and removing any tendency to vibration. The eccentric and change gears are readily accessible so that settings for any curve can be quickly made.

Other standard features of the company's grinders have been incorporated in this machine, and improved where possible. These features include: dead center, head and footstocks; flexible faceplate drive; angle, water shedding front bed; centralized controls at the operator's station; flood-lubricated, inverted "V" ways; flexible steel covers for the carriage ways and drive rack; double helical gears to worm and rack traverse drive, and multiple V-belt spindle drive.

Shipping weight of the machine is 177,000 lb. and the floor space area is 15 ft. 2 in. by 40 ft. 7 in., including foundation.

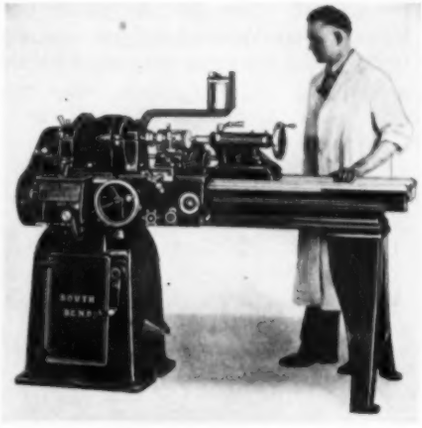


Front view of Farrel-Birmingham 60 In. by 20 Ft. Roll Grinder from the tailstock end, showing a 75,000-lb. roll under test

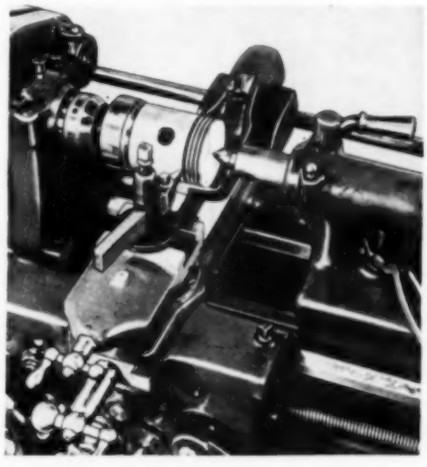
South Bend Cam Piston Finishing Lathe

The South Bend Lathe Works, South Bend, Ind., is introducing a cam piston finishing lathe designed to machine both round and out-of-round pistons. This lathe will service all cam-shaped pistons now being used in automotive engines and can be set up quickly to finish pistons of practically any diameter, material or shape, and in straight or tapered types.

The machine is a 13-in. underneath-



South Bend 13-In. Underneath-Belt Motor-Driven Cam Piston Finishing Lathe



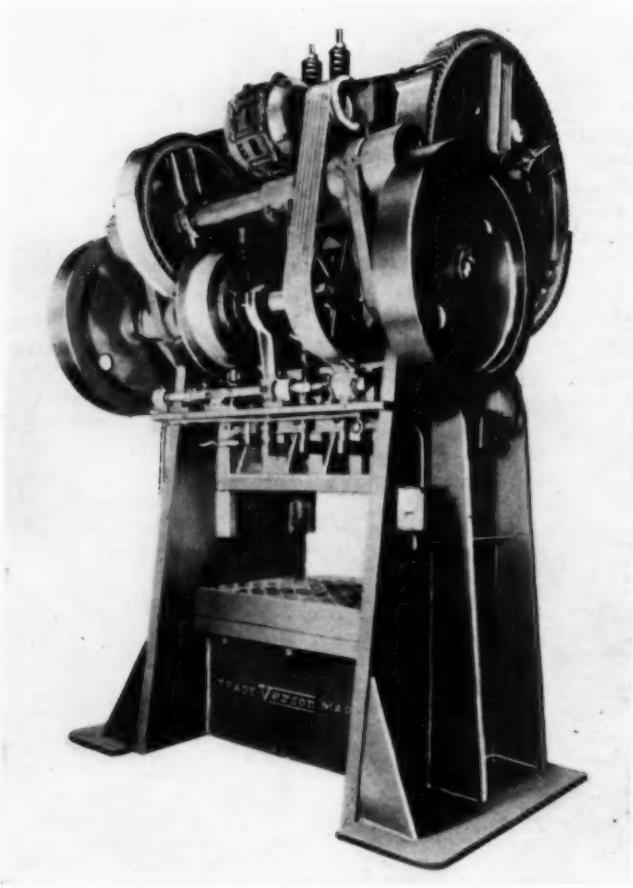
Close-up showing a cam-shaped piston in the lathe and the master cam at the rear of the carriage

belt motor-driven lathe with a cam forming unit mounted on the lathe carriage at the rear of the saddle. This cam forming unit is geared to the lathe spindle so that as the spindle rotates, it also rotates the master cam. The toolslide is caused to oscillate back and forth according to the throw of the cam, thus turning the skirt of the piston to a perfect oval, ellipse or any other shape desired. Machining is done with a tool tipped with tungsten carbide. Light cuts and fine feeds with the lathe running at relatively high speeds produce a surface on the skirt of the piston which is smooth and on alloy pistons a surface which is highly polished. Up to twenty-five sets of six pistons can be machined in an ordinary work day. The equipment is available in three sizes.

"Verson" Double-Crank Presses with Solid Frame

To complement the double-crank tie-rod frame presses previously announced, the Allsteel Press Co., 12015 S. Peoria St., Chicago, Ill., is now building a line of "Verson" double-crank presses with solid frames. These presses are built in all sizes and capacities and also to suit the user's particular requirements. They are of welded steel-plate construction, require no pit and are accessible all around. The friction clutch and brake are air-operated and are mounted between the housings, together with the motor and drive. The high-speed back-shaft runs in roller bearings. Lubrication is by the automatic force feed method. Motor adjustment of the ram is provided. The steel gibs and gibways are faced with renewable bronze liners.

Illustrated is a No. 956 Verson press of 350-tons capacity with a 9-in. shaft, 42x56-in. bed area, 16-in. shut height, 8-in. stroke, 6-in. adjustment. This press operates at 20 strokes per minute and has a gear ratio of 25 to 1. Overall floor space is 68x98 in. Power is furnished by a 20-hp., 1,200 r.p.m. motor with push-button control, while ram adjustment is provided by a 1-hp., 1,800 r.p.m. motor and reversing switch.



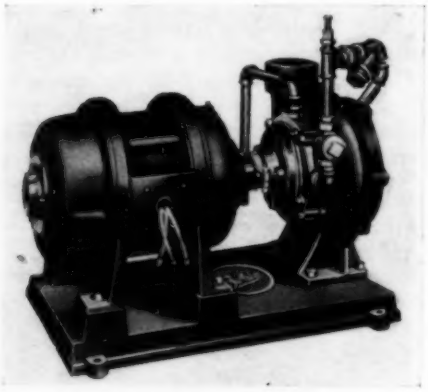
Rear view of "Verson" No. 956 Welded Steel Press of 350 tons capacity. This view shows the compactness of the machine

St. John X-Ray Paper

The St. John X-Ray Service Corp., 505 Fifth Ave., New York, N. Y., has developed an X-ray paper which is said to be cheaper than film, dries faster and needs only one intensifying screen instead of a pair. Two sheets are exposed simultaneously in one cassette. This has the advantage that one negative can be retained while the other one goes along with the material. The developing time for paper is 3 min. at 68 deg. F., using special chemicals that have been developed by the company.

Buffalo Single-Suction Self-Priming Pump

A built-in self primer is a feature of the single-suction pump developed by Buffalo Pumps, Inc., Buffalo, N. Y. The self-primer is built under license from the Nash Engineering Co. The pump, which is known as the Type CP, is available with two types of impellers; on sump service, or wherever liquids are not clear, the open type is recommended, while for all other services the



A self-priming device is built integral with the casing of this Buffalo Single-Suction Pump

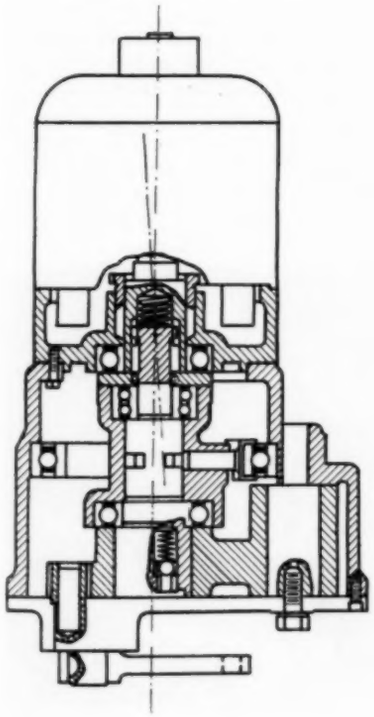
inclosed impeller is commonly supplied. For general service, bronze impellers are furnished. The pump shaft, bronze covered, is an extension of the motor shaft, carrying impellers for pump and primer. With this construction no bearings are used in the pump, the thrust and radial loads being taken by the motor bearings. The pump is built in several sizes in capacities up to 450 g.p.m., and for heads up to 150 ft.

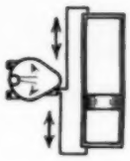
Welco Self-Contained Hydraulic Generator

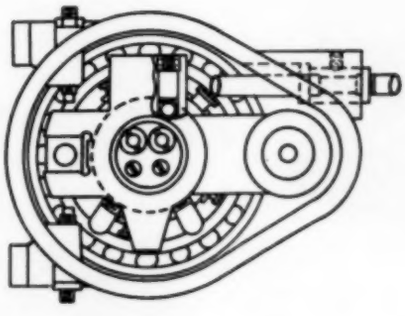
The B. A. Wesche Electric Co., 1622-1628 Vine St., Cincinnati, Ohio, has developed a self-contained hydraulic generator that is claimed to operate at high efficiency without undue heating, and which does not require oil storage tanks nor relief valves. The generator is of the variable-delivery type, and the rotor carries five generator pistons mounted as a pendulum. Reactance to the generated oil pressure is taken on a spring mounted in the cartridge, one end of which is in contact with a piston under pressure. In this way the rotor is held in equilibrium until displaced by the screw, plunger or cam adjustment. By changing the spring the pump can be made to operate at any pressure up to 5,000 lb. per sq.in. There are only seven moving parts in the unit and anti-friction bearings are employed wherever practicable.

The hydraulic unit is driven by a constant-speed motor, and the ordinary working pressure of the pump is 1,500 lb. Reversal of the work-operating piston can be controlled electrically or mechanically. The speed of the work piston can be constant or variable independent of the load applied when the load is within capacity of setting. The hydraulic overload feature automatically regulates the generator displacement until the mechanism is operating at the predetermined load in ft.-lb. In this case, the speed of work-operating piston is reduced proportionately when overloaded. Where a mechanical overload feature is required, it operates by varying the displacement of the pump, the cycle of operation being continued when the overload is removed. With the mechanical overload mechanism, the predetermined working pressure is not exceeded. The generator can be operated in any position. Temperature rise is said to be practically negligible during continuous operation at full load.

Sectional views and symbolical sketch show operation of "Welco" Self-Contained Hydraulic Generator. Reversal of the work-operating piston can be accomplished electrically or mechanically

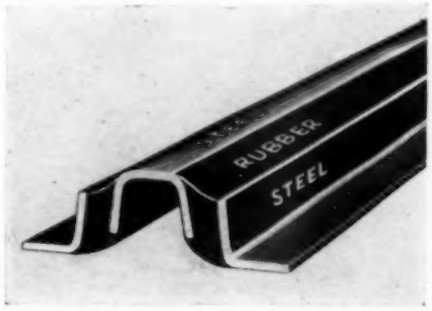






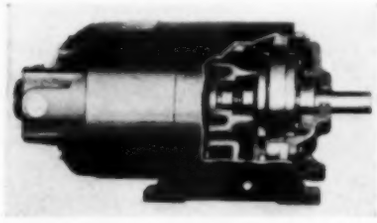
Firestone Vibration Dampener

A vibration dampener that can be cut to length, or used in any number of lengths, is now being placed on the market by the Firestone Tire & Rubber Co., Akron, Ohio. Standard lengths are 12, 24 and 36 in. Three densities or hardnesses of rubber compound, soft, medium and hard, are made to afford a wide range of load capacities. As illustrated, this device is made by bonding cushion strips of rubber between pieces of brass-plated metal. The central inverted metal "U" carries the load, and the extended metal feet on either side are bolted to the foundation. The dampener carries the load in shear. The normal position is to have the feet of the dampener secured to the flooring or foundation but it functions in the reversed position, countersunk. Holes for bolts or screws are drilled on the job. The rubber connector strips absorb and stop vibration caused by the machine as well as protect the insulated machine against vibration transmitted to the metal feet from without.

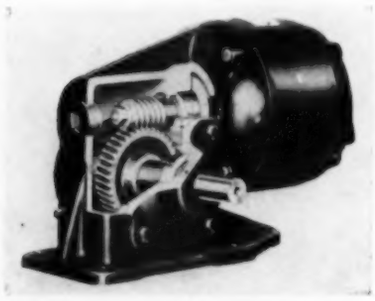


General Electric Fractional-Hp. Gear-Motors

Two types of fractional-horsepower gear-motors are available from the General Electric Co., Schenectady, N. Y., both types in ratings from ⅛ to ¾ hp. The concentric-shaft type is built with speeds from 500 to 98 r.p.m., and the right-angle shaft type is made with speeds from 200 down to 11 r.p.m. The gear-motors utilize the planetary type of gearing with concentric shafts in the smaller ratios and worm gears singly or in combination with the planetary type in the higher ratios. The designs employ "Textolite" pinions, helical gears, and quiet running worm gears.



Cut-away view of General Electric Concentric-Shaft Type Fractional-Horsepower Gear-Motor, showing internal parts



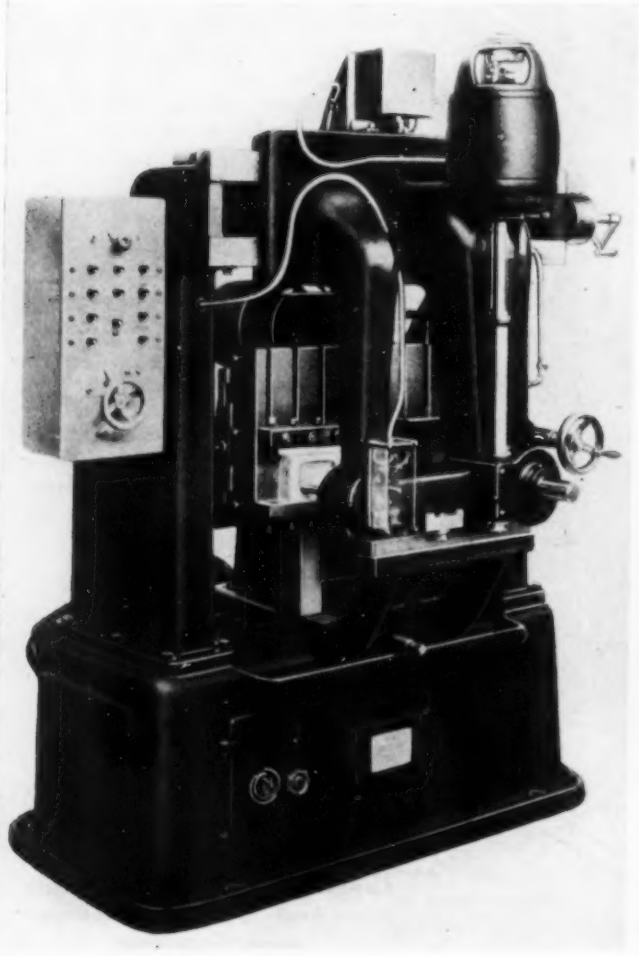
Cut-away view of General Electric Right-Angle Type Fractional-Horsepower Gear-Motor

Hisgen-Nube-Watford Automatic Die-Sinking and Profiling Machine

An electrically controlled automatic die-cutting and profiling machine is now being offered by the Hisgen-Nube Machine Co. (American Division), 117 W. Lake St., Chicago, Ill. This machine is specially constructed for large and heavy work on blanking and forming dies, bakelite and die-casting molds, and will reproduce from a soft pattern or model or from a template the minute details of a form or shape. The copying mechanism works in a ratio of 1-1. All motions of the machine are effected by special reversing motors incorporating a dynamic brake. Thus magnetic clutches are avoided. All motions are automatically controlled by the tracer mechanism when automatic operation is desired. Semi-automatic operation is possible by means of a push-button control cabinet placed immediately in front of the operator. Hand control is also available.

The bed carries the table and die and pattern holders which are moved by a feed screw to bring the work nearer to the tracer and cutter. This primary motion is controlled by hand. The tracer and cutter head are mounted in a rigid housing. There is practically no pressure on the tracer, and as it moves easily an ounce pressure or so will cause it to make contact, and the relays start the machine automatically. When the machine is in operation the pressure on the tracer is relieved.

As all motions are effected by separate motors, the cutter is forced to enter the die-block and take heavy cuts if desired, entirely independently of the sensitiveness of the tracer which controls only the confines of the form or contour to be cut. Four sizes of machine are built. The first has capacity as follows: Maximum length of die, 16 in.; maximum width of die, 12 in.; and maximum thickness of die, 12 in. The largest size has capacity as follows: Maximum length of die, 75 in.; maximum width of die, 36 in.; maximum thickness, 26 in.

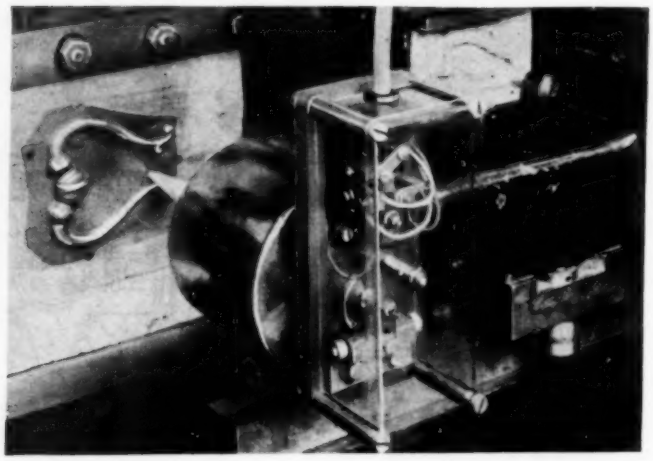


DeVilbiss Type MB Spray Gun

Light trigger control is found in the Type MB spray gun now offered by the DeVilbiss Co., Toledo, Ohio. An air piston relieves the spring tension on the fluid needle when the air valve is opened. Thus, the trigger pull need only be strong enough to open the air valve. A larger air passage allows a greater volume of air in the head and as a result permits better atomization and lower air pressure. The graduated spray width adjustment has been perfected through the addition of larger air passages in the port openings. Cleaning of the removable spray head has been simplified. The body of the gun is a heat-treated aluminum alloy forging and the spray head barrel is supplied either in brass or aluminum.

Left—Only a small amount of finishing is required after sinking large dies and molds on the Hisgen-Nube-Watford Automatic Die-Sinking and Profiling Machine

Below—Close-up of the magnetic tracer mechanism that controls the automatic operation of the machine



Two-Wheel Automatic Cycle for Heald Internal Grinders

Automatic cycles have been developed by the Heald Machine Co., Worcester, Mass., whereby its machines can be used in production with two wheels on the same spindle. With one cycle both rough and finish grinding with two wheels on the spindle can be done, and with the other cycle grinding and polishing are performed.

As shown by the accompanying sketch, Fig. 1, the sequence of automatic operation for rough and finish grinding with two wheels on the one spindle are: start; rough grind, using rear wheel; true both wheels, and set dog bar for finishing; finish grind, using front wheel; and run out, resetting dog bar. This particular machine is arranged as a single "Gagematic" having a truing contact on the handwheel, "Sizematic" fashion, and the finishing contact in the plug sizing device. When the table runs out for truing, a lever carried on the right-hand end of the dog bar rides over a cam, which raises the latches on the stroking dogs by means of a rack and pinion. At the same time other latches drop into position to allow the finishing wheel to grind. A special retraction mechanism is incorporated in the plug sizing device to keep the gage retracted from the projecting wheel during rough grinding.

Since roughing is done by the rear wheel, some arrangement is necessary to back off the cross-slide when the table runs out for truing, in order to prevent the front wheel from striking the ground surface. This feature is shown in Fig. 2, and is similar in principle to the standard type of backing-off attachment. A lever is attached to the rear end of the cross-slide screw in such a manner that when the end of the lever is raised, the slide backs off.

Where stock conditions are severe, the method and arrangement described allows maximum production to be obtained, by permitting the selection of a relatively coarse, free-cutting wheel for roughing, and a fine hard wheel for finishing. Time is saved and greater accuracy is secured by finishing the parts in one chucking.

Where stock conditions are more nearly normal and the highest possible finish is desired, the two-wheel arrangement, one grinding and one polishing, is satisfactory. This method produces a finish nearly as smooth as that obtained by lapping, and at the same time maintains close tolerances for roundness and straightness. Such a set-up is shown in Fig. 3. A variation of the arrangement just described was applied to a double-gage machine. Roughing, truing and finishing are done in the normal Gagematic manner with the front wheel under the control of roughing and finishing gages. When the finishing gage enters the work a valve in a secondary control box is actuated to allow oil to enter the hydraulic cylinder at the right end of the dog bar, to move the whole dog bar endwise. This brings the rear wheel into grinding position. The rear or polishing wheel is, of course, impregnated with abrasives and is allowed to float back and forth in the hole under very little feed or none at all until the time relay makes contact, when the table runs out in the usual way. A hydraulic backing-off attachment is employed.

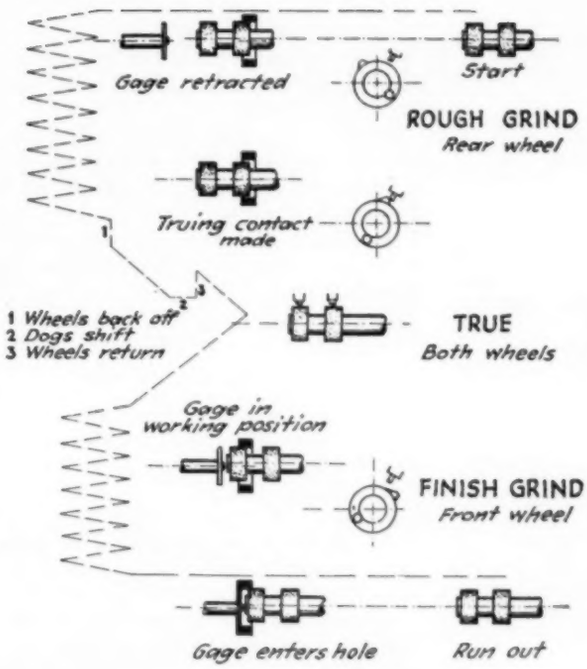


Fig. 1—Schematic diagram of automatic grinding cycle as applied to a Heald internal grinder for rough and finished grinding at one chucking

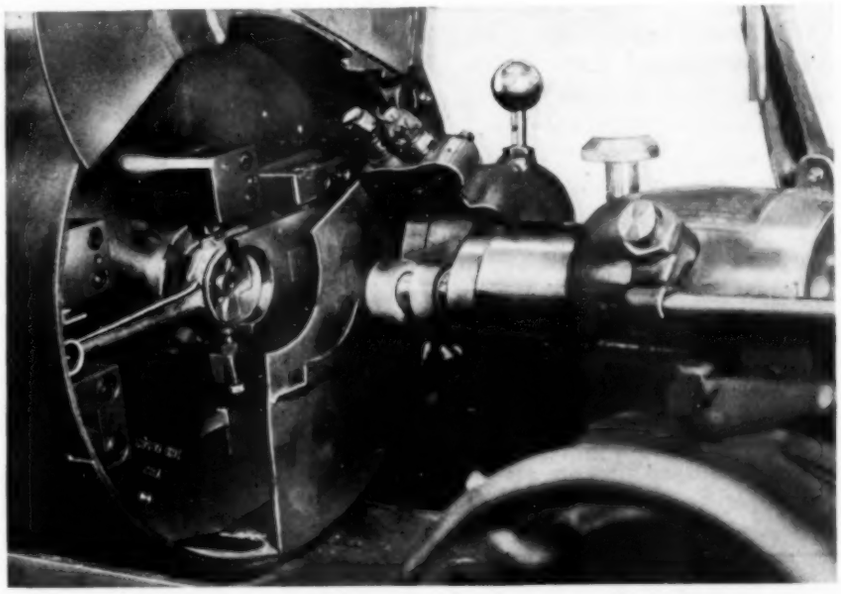


Fig. 3—Heald internal grinder set up to grind and polish with two wheels on one spindle. The rear wheel is the polishing wheel

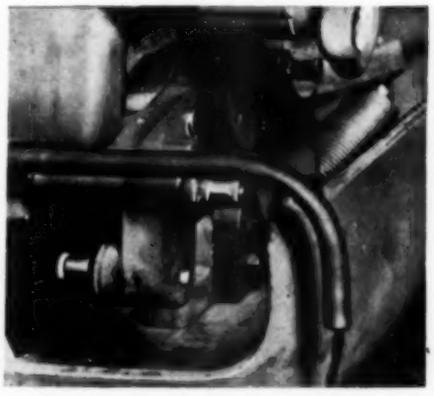


Fig. 2—A cam in the water pan raises a lever that causes the cross-slide to back off

Westinghouse Mercury Switch

Six refractory - protected mercury switches have been developed by the Westinghouse Lamp Co., Bloomfield, N. J. These switches are made in ratings from 3 to 50 amp., in the single-pole, single-throw type, and may be operated in either a.c. or d.c. circuits. Contact is made by an impact between

Comparative size of Westinghouse 50- and 3-Amp. Mercury Refractory-Protected Switches

two pools of mercury within a refractory chamber encased in heavy glass walls. Instead of flowing slowly together, the mercury from one pool drops to meet the other. Inert gas within the chamber keeps the mercury chemically pure and also dissipates the heat of the arc. The switches vary from 0.410 to 1.270 in. in diameter and from 2 to 4⅛ in. in over-all length, not including the leads. Flexible leads from 6 to 8 in. long are provided. Terminal wires are sealed in glass.

• PATENTS •

MAY 2, 1933

Metal-Working Machinery

Electric Welding Machine. Max Edwin Lobley, New York, N. Y., assigned to American Circular Loom Co., Inc. Patent 1,906,323.

Fluid Actuated Controlling Mechanism for Multispindle Drills. Ralph M. Lovejoy, Boston, Mass. Patent 1,906,387.

Steady Rest for Crank Shaft Lathes. William F. Groene, Cincinnati, Ohio, assigned to The R. K. Leblond Machine Tool Co. Patent 1,906,577.

Method of and Apparatus for Relieving Face Mill Cutter Blades. Thomas M. Durkan, Rochester, N. Y., assigned to Gleason Works. Patent 1,906,845.

Tools and Attachments

Chuck. Charles H. Schurr, Cleveland, Ohio, assigned to The Lees-Bradner Co. Patent 1,906,424.

Chuck. Stuart W. Parsons and Gustave R. Dahlman, New Britain, Conn., assigned to The Skinner Chuck Co. Patent 1,906,714.

Apparatus for Cutting Rack Bars. Peter Parr, Normandy, Mo. assigned to Metallic Sash-Operator Co. Patent 1,907,000.

MAY 9, 1933

Metal-Working Machinery

Vertical Spindle Machine Tool. Carroll Knowles, West Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,907,550.

Flanging Machine. Edgar Preston, North Kansas City, and Otto N. Gredell, Kansas City, Mo., assigned to Standard Steel Works. Patent 1,907,664.

Lapping Machine. Sydney Player and Herbert S. Indge, Westboro, Mass., assigned to Norton Co. Patent 1,908,048.

Machine for Bending Sheet Metal Shapes. Albert Rafter, Belleville, N. J., assigned to Rafter Machine Co. Patent 1,908,182.

Machine for Generating the Teeth of Wheels. Sam Sunderland, Lyndhurst, Keighley, and Arthur Maurice Midgley, Threshfield, near Skipton, England. Patent 1,908,195.

Multiple Cutter Milling Machine. Carl H. Leis, New Castle, Pa., assigned to Johnson Bronze Co. Patent 1,908,262.

Machine for Sharpening Gear Cutters. Schuyler H. Earl, Rochester, N. Y., assigned to Gleason Works. Patent 1,908,476.

Oscillating Grinder. Charles E. Van Norman, Springfield, Mass., assigned to Van Norman Machine Tool Co. Patent 1,908,577.

Tools and Attachments

Automatic Chuck. Axel G. Lundin, Blairstown, N. J., assigned to American Machine & Foundry Co. Patent 1,907,553.

Routing Tool. Vernon Royle, Paterson, N. J. Patent 1,907,880.

Feed Collet. Irving H. Sheffer, Detroit, Mich. Patent 1,908,000.

Grinding Fixture for Thread Cutting Tool Bits. John Jorgensen, Bridgeport, Conn. Patent 1,908,155.

Grinding Mechanism. Frank J. Jeschke, Detroit, Mich., assigned to Micromatic Hone Corp. Patent 1,908,252.

Processes

Method of Manufacturing Metallic Gear Wheels. Aubrey A. Ross, Marblehead, Mass., assigned to General Electric Co. Patent 1,908,187.

Method of Beading a Cylindrical Sheet Metal Shell. Bror J. Lindgren, Buffalo, N. Y., assigned to Niagara Machine & Tool Works. Patent 1,908,521.

• TRADE PUBLICATIONS •

AIR COMPRESSORS. The Allis-Chalmers Mfg. Co., Milwaukee, Wis., has available Leaflet 2159 on single-stage, water-cooled rotary air compressors, having a range of volumes from 50 to 2,000 c.f.m. at pressures up to 150 lb. and vacuum up to 29.85 in. of mercury.

AIR VALVES. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa., is distributing Bulletin YB-2001 on the "Yarway-Becker" automatic air control valve for pneumatic tools, recently announced in these pages.

BENCH MILLING MACHINES. Both horizontal and vertical bench milling machines are described and the specifications are listed in the circular now available from the Hardinge Bros., Inc., Elmira, N. Y. The various types of attachments are also described.

DOUBLE CRANK PRESSES. Series No. 60 double-crank power presses are described in Bulletin No. 64-D issued by the Niagara Machine & Tool Works, Buffalo, N. Y.

DURONZE ALLOYS. High-strength silicon bronzes marketed under the trade name of "Duronze" are described in the new booklet being issued by the Bridgeport Brass Co., Bridgeport, Conn. These alloys are made in three grades, information being given concerning the strength, uses, corrosion resistance and toughness.

PATENTS AND TRADE-MARKS. Richards & Geier, 274 Madison Ave., New York, N. Y., is distributing gratis a book "Patents, Trade-Marks, Copyrights-Law and Practice," by Oscar A. Geier, cloth bound, 6x9 in., 128 pages. The book, a sixth edition, is written in terms for the business man, and covers the essential features of patent, trade-mark and copyright laws.

PYROMETERS. Indicating pyrometers for panel and wall mounting, as well as portable use, are shown in the leaflet describing the Model 20 line issued by the Mishawaka Industrial Instrument Mfg. Laboratory, 936 Washington Ave., Mishawaka, Indiana.

WELDING STAINLESS ALLOYS. Comprehensive information on the various welding methods, as applied to different types of "Enduro" stainless alloys, is presented in the booklet "The Welding of Enduro Stainless Alloys," 18 pages, recently released by the Republic Steel Corp., Central Alloy Div., Massillon, Ohio.